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A COMMAND AND CONTROL VEHICLE
FOR THE LIGHT CAVALRY REGIMENT
OF A CONTINGENCY CORPS

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

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by

MARK W. MAIERS, MAJ, USA
B.S., UNIVERSITY OF NEW YORK AT ALBANY, NEW YORK, 1986

Fort Leavenworth, Kansas
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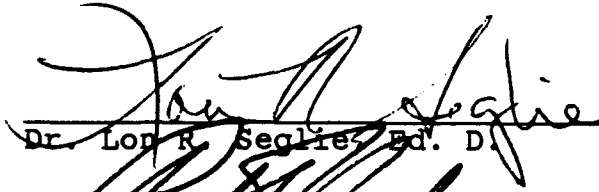
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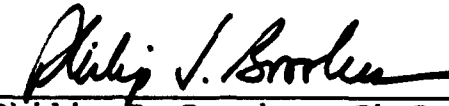
Approved by:


Dr. Lon R. Seglie, Ed. D., Thesis Committee Chairman


Colonel Robert Hurley, M.S., Member


Lieutenant Colonel Jon Moilanen, M.A., Member

Accepted this 5th day of June 1992 by:


Philip J. Brookes, Ph.D., Director, Graduate Degree
Programs

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency.

ABSTRACT

A COMMAND AND CONTROL VEHICLE FOR THE LIGHT CAVALRY REGIMENT OF A CONTINGENCY CORPS by Major Mark W. Maiers, USA, 78 pages.

This study compares four vehicles as possible candidates for a command and control vehicle for use by the Light Cavalry Regiment employed in support of a contingency corps. The need for a new command and control vehicle is based on the premise that the current M577 Carrier, Command Post may not be the best candidate for the Light Cavalry Regiment.

Current "light" organization command post operations are presented along with the proposed organization and mission profile for a Light Cavalry Regiment (LCR) operating as part of a lodgement operation for a contingency corps.

The variants considered in the study are four vehicles which are all currently in the U.S. Army inventory but not necessarily currently fielded in a command and control role.

In this study decision matrixes compare the variants and provide a raw score in the areas of survivability, mobility, compatibility, user orientation and deployability. A final matrix compares each vehicle's raw score. This data provides the recommendation that the FUCHS vehicle is the best command and control platform for the LCR.

ACKNOWLEDGEMENTS

I would like to thank the personnel at the Combined Arms Center-Combat Developments for their assistance in providing information on the evolving structure of the Light Cavalry Regiment as discussed in Chapter 1. Additional help was provided by the personnel of the Natick Laboratory who provided information and pictures of the Standard Integrated Command Post. The other diagrams of the HMMWV, HEMTT, LAV-25 and Bradley vehicles in this study were extracted directly from the technical manual for that vehicle. The "Janes" manuals provided some of the diagrams for the HEMTT and the German Liaison Office of Fort Leavenworth provided the sketches and technical data for the FUCHs vehicle. Finally, my thanks to my committee members, the staff of the Command and General Staff College, the personnel of the Graduate Degree Program Office and my family for their assistance and patience in the completion of this study.

TABLE OF CONTENTS

LIST OF FIGURES.....	vii
CHAPTER 1	
INTRODUCTION.....	1
Thesis Statement.....	5
Scope.....	5
Definitions, Limitations, and Delimitations.....	6
The Light Cavalry Regiment (LCR).....	6
The TAC and the TOC.....	8
Delimitations.....	10
Limitations.....	11
Thesis Outline.....	13
CHAPTER 2	
LITERATURE REVIEW.....	15
Other Current "Light" Command Posts.....	15
U.S. Army Light Infantry Division.....	15
The Marine Command Post.....	18
Research and Information Sources.....	20
CHAPTER 3	
METHODOLOGY.....	24
Methodology Criteria Definitions.....	25
Methodology Model.....	26
Weighting Criteria.....	27
CHAPTER 4	
ANALYSIS OF SELECTED VARIANTS.....	29
Vehicle Descriptions and Capabilities.....	29
The HMMWV Variant.....	29
HMMWV Description.....	31
The HEMTT Variant.....	33
HEMTT Description.....	37
The Bradley Variant.....	39
BRADLEY Description.....	40
The FUCHS Variant.....	44
FUCHS Description.....	45

Comparison of the Four Variants.....	48
Mobility.....	48
Survivability.....	51
Compatability/Cost.....	54
User Oriented.....	55
Deployability.....	58
CHAPTER 5	
RECOMMENDATION AND CONCLUSION.....	60
Conclusion.....	63
APPENDIX 1	
SAMPLE SURVEY.....	66
APPENDIX 2	
THE LAV-25.....	67
BIBLIOGRAPHY.....	71
INITIAL DISTRIBUTION LIST.....	75

LIST OF FIGURES

Figure No.

CHAPTER 1

1. Light Cavalry Initial Deployment.....8
2. Light Cavalry Follow-On Deployment.....9
3. Light Cavalry Regiment.....10
4. Headquarters and Headquarters Troop (Light Cavalry Regiment).....11
5. Light Cavalry Squadron (Light Cavalry Regiment).....12

CHAPTER 2

1. Tac CP Layout (2nd Bde, 7th ID).....16
2. TOC Internal Layout (2nd Bde, 7th ID).....17
3. MCATF Command and Control Elements.....19
4. Assault Amphibious Command Vehicle, LVTC-7.....20

CHAPTER 3

1. Comparative Analysis Model.....26
2. Interval Scale.....27

CHAPTER 4

1. M997 Maxi-Ambulance.....30
2. Right Rear view of the Maxi-Ambulance.....32
3. Oshkosh M977 Heavy Expanded Mobility Tactical Truck (8 X 8).....33

4.	S-783/S-784, S-785/S-786 Expandable Shelters...	35
5.	Left Front View (HEMTT).....	38
6.	Right Rear View (HEMTT).....	38
7.	Bradley Interior Arrangement.....	40
8.	Bradley Fighting Vehicle (Left Front View).....	41
9.	Bradley Fight Vehicle (Right Rear View).....	42
10.	Bradley Vehicle with Swim Barrier Erected.....	43
11.	FUCHS (front, Side, and Rear View).....	45
12.	FUCHS Interior Arrangement.....	46
13.	Mobility Matrix.....	50
14.	Survivability Matrix.....	53
15.	Compatability/Cost Matrix.....	54
16.	User Oriented Matrix.....	57
17.	Deployability Matrix.....	59
 Chapter 5		
1.	Rank Order/Weighting of Criteria.....	61
2.	Best Variant Matrix.....	62
 APPENDIX 2		
1.	The General Motors 8X8 Command and Control Vehicle.....	67

CHAPTER 1

INTRODUCTION

As the requirements for mobility, flexibility and dispersion of units become increasingly apparent on the battlefield, the problems of control and coordination are magnified. The focal point for control and coordination is the command post, hence it is essential that this installation be capable of effective, continuous operation regardless of circumstances...command posts can no longer afford time previously consumed by facility erection and dismantling. (The command post vehicle) should be capable of cross-country operations, have an amphibious capability of crossing inland water obstacles, and be suitable for use in all climatic conditions. It should be air transportable in Air Force cargo and assault-type aircraft and...should be transportable by army helicopter using external sling-carry means. The vehicle should contain an integral power source, separate from that required for vehicular movement. Facilities should include necessary flooring, siding, and roofing to permit easy, quick assembly of several units. Facilities such as map boards, lights, power outlets, heat, ventilation, and blackout capabilities will be built in. The vehicle should provide built-in protection from shell fragments and chemical, biological and radiation effects. To the extent feasible, replaces various standard tentage used for command posts.¹

The preceding quote sounds like an excellent concept document for a command post vehicle. Amazingly enough, all

¹Mobile Command Post Vehicles. CDOG Project Nr USACGSC 57-4, 15 July 1958. Fort Leavenworth Archives #N-18378.128B

those previous requirements come from a study conducted in July of 1958. Unfortunately, the military has been struggling with the various forms of vehicular command posts ever since it has had to command and control motorized or vehicular mounted tactical formations.

This study will attempt to identify a vehicle already in the Army inventory that might be a better solution for a command and control vehicle for the Light Cavalry Regiment rather than the M577 Carrier, Command Post vehicle.

A command post (CP) is the principle facility employed by the commander to command and control combat operations. A CP consists of those coordinating and special staff activities and representatives from supporting Army elements and other services that may be necessary to carry out operations.²

Currently, command posts are big, heavily staffed organizations built around a myriad of vehicle types. Most command posts, including the current command posts for the light infantry divisions, are based on some type of transport vehicle and housed primarily in tents.

The significant problem with this light division design is that once positioned it is basically immobile. It takes time to setup and time to take back down. It has no command and control capability while on-the-move. It therefore requires duplication in one form or another (ground or

²FM-101-5-1, Operational Terms and Symbols, Hqs, Department of the Army, Washington, D.C., Oct 1985, p 1-17.

airborne "jump" CP) to provide continuity.

Most command posts in the heavy divisions are based on our current M-577, the Carrier, Command Post. This vehicle, when compared to the current M1A1 and M2/M3 fleet, is too slow, too unreliable, and too limited. The M577A1/A2 is unable to keep pace with our current Bradley and M1 fleet. It lacks protection in an NBC environment and provides little protection from penetration or spall effects. A U.S. Army Armor Center report on Operation Desert Storm states, "the M577 was inadequate as a command and control vehicle during the operation...the need for new, perhaps Bradley/MLRS based, C3I...vehicle is clear."³

Even the builder of the M577s, FMC Corporation, realizes this insufficiency and has proposed yet another modification and rebuild of the basic M577, currently known as the XM577A3. It would be inequitable not to mention this experimental vehicle's proposed capabilities. The XM577A3 has a combat weight of 31,800 pounds which would rank it less than the FUCHS, a variant evaluated in this study. It is roughly the same height as a BRADLEY when reduced (102 inches). It has a 300-mile range and a maximum speed of 40 mph, which means it is still slow compared to the BRADLEY or the M1 tank. FMC promises an interior of 502 cubic feet, "hybrid NBC protection, air conditioning, bolt-on armor (side, top, and

³Memorandum dtd 24 July 91, U.S. Army Armor Center and Fort Knox, Subject: United States Army Armor Center Desert Shield/Storm Emerging Observations Executive Summary, p 16.

belly) and a composite panel spall liner." The proposed price per vehicle was not available.⁴

The current M577 can communicate during movement but can hardly perform those functions associated with command post operation, such as administrative functions and planning once the canvas extensions come down, the lights go out, and the ramps are closed.

The Army needs a command post that can operate on the move as well as provide a better work area with better protection and better capabilities. A command and control system must provide tactical commanders with flexibility and mobility. CPs must be able to collect, analyze, and present information rapidly, and communicate orders, coordinate support, and provide direction to forces. The CP vehicle must have the characteristics of reliability, survivability, mobility, speed, and durability.⁵ This thesis, will examine a number of options for a basic command post vehicle. It will concentrate on vehicles that are already in the field and have established performance records, repair parts stockage, and trained mechanics. It contends that one or more of the four

⁴FMC Factsheet, The XM577A3, Armored Tactical Command and Control System, FMC Corporation, Ground Systems Division, Santa Clara, California, May 1991.

⁵Goedkoop, Thomas R. The Task Force Tactical Operation Center: An Organization for Success, Master of Military Art and Science Monograph, US Army Command and General Staff College, 1988, p 22.

variants used in this study will do a better job than the M-577 for the Light Cavalry Regiment.

Thesis Statement

Given four currently fielded variants, which vehicle is best suited as a command and control vehicle for the future LCR command post? A new organization has been proposed by the United States Army Armor Center and Fort Knox for the Light Cavalry Regiment (LCR). This new type of cavalry regiment will be discussed later in Chapter 2. It is the command and control vehicle which is the focus of this study.

Scope

In selecting a base vehicle which is the best for future LCR operations, the intent of this study is to stay within the bounds of currently known technologies. All but one of the variants presented have already been tried in previous command post tests. Moreover, this study will not apply any future technologies in the way of command and control equipment to the selected base vehicle unless it is an item already selected for fielding.

The study will present a number of CP functions which will be applied in the analysis of each command post vehicle

variant. This study will attempt to define each of these functions based on my concept of possible LCR deployment scenarios. The method for the analysis will be fully explained in Chapter 2.

Definitions, Limitations, and Delimitations

DEFINITIONS

The Light Cavalry Regiment (LCR)

The baseline of this study is the future Light Cavalry Regiment (LCR). The following paragraphs present the current state of information regarding this organization. This information is the most current available at the time of this writing as provided by the Combined Arms Center for Combat Developments at Fort Leavenworth.

The current concept for a Light Cavalry Regiment is a unit that:

- maintains a quick reaction package to support contingency operations.

- deploys immediately after the initial entry force to rapidly expand security for the airfield/port of debarkation (APOD). Air superiority is assumed.

- performs specified cavalry tasks for a corps.

- uses augmentation to provide METT-T⁶ unique

⁶Considerations used in mission planning, i.e., Mission, Enemy, Terrain (and weather), Troops, and Time available. FM 100-5.

capabilities (infantry, air defense, etc.)

- operates with mobility and stealth to cover large areas and great depths.

- maximizes use of long range fires (Tactical Air, Multiple Launch Rocket System [MLRS], Army Tactical Missile System [ATACMS], and helicopters).

The missions for the LCR as envisioned by the U.S. Army Combined Arms Center, Combat Developments Directorate (CAC-CD) include:

- deployment by air

- traditional reconnaissance/security missions for contingency forces to include:

- zone, route, area reconnaissance

- screen, guard, cover

- attack, defend, delay

- Deployment in squadron or task organized packages (heavy/light/aviation).

- operation across continuum of military operations

- strategic deterrence.

Figures 1 and 2 on the following pages illustrate a proposed light cavalry squadron in the initial deployment phase and the follow-on deployment. Figures 3-5 depict the organizations and equipment of the current proposed LCR structure by CAC-CD. CAC-CD is responsible within the U.S. Army for designing the equipment and organizational structure of future units.

[illegible]

Figure 1 This figure depicts the lead squadron of a LCR as it would be deployed in a contingency mission.

Tactical Command Post and Tactical Operations Center

First, a definition is required of command post operations and the functions and responsibilities of what is known as the TAC and the TOC (Tactical Command Post and Tactical Operations Center).

Most organizations echelon their CPs with a tactical

LIGHT CAVALRY FOLLOW-ON DEPLOYMENT

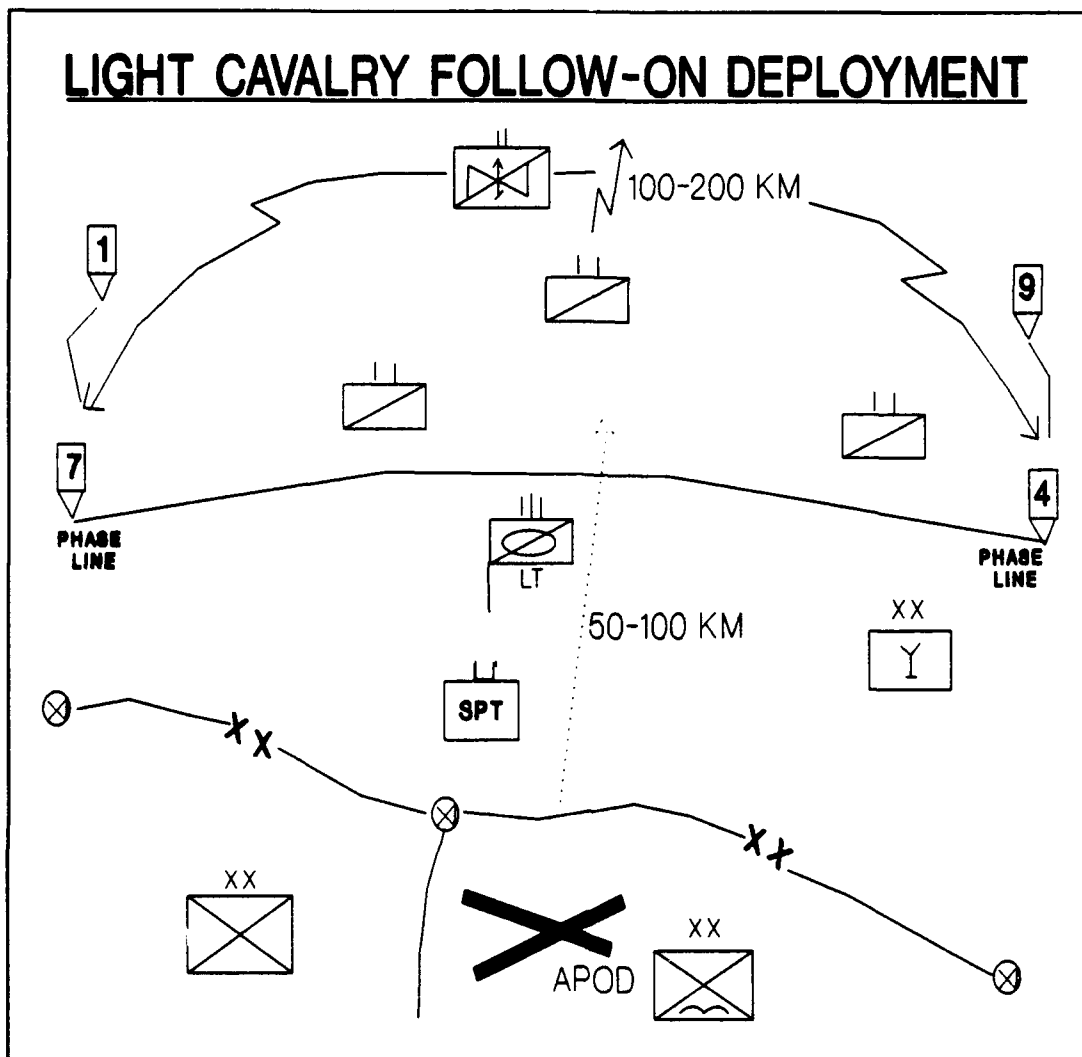


Figure 2 This figure depicts the deployment of the entire light cavalry regiment. It is now deployed to cover much greater distances and provide early warning.

command post, known as the TACP (or just the "TAC") located forward with committed forces and the main CP or TOC (sometimes called "the Main") located further to the rear of the battle area. The primary mission of the TAC is the control of the current battle. The primary mission of the TOC is sustainment of current operations and planning for future operations.

LIGHT CAVALRY REGIMENT

CAC RECOMMENDATION

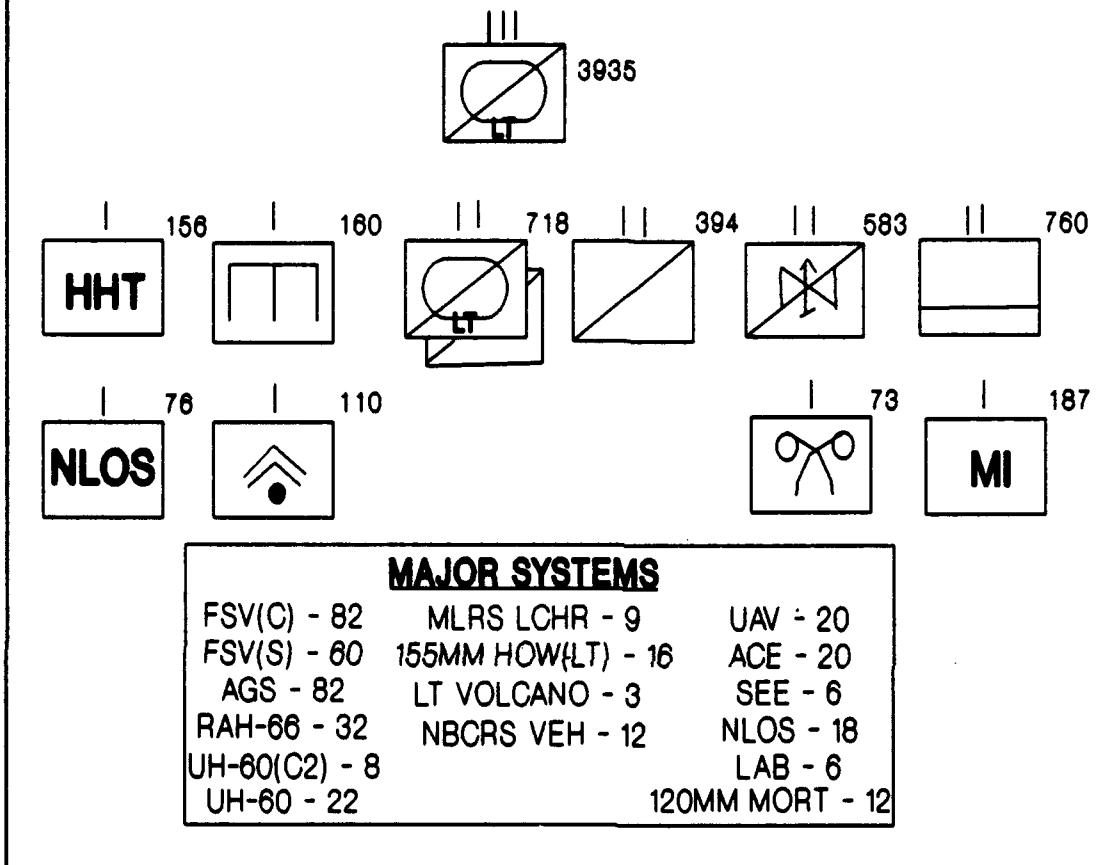


Figure 3 Centerpiece to this organization is the Light Cavalry Squadron. The regiment would also include a reconnaissance and aviation squadron, a MLRS battery, and a Non-Line-of-Sight Weapon company.

DELIMITATIONS

Currently, most mechanized units have the M577 Carrier, Command Post as the primary C2 vehicle. The primary focus of this study is to recommend a replacement for the M577. Other command post functions, equipment or manning issues will not be discussed.

HEADQUARTERS AND HEADQUARTERS TROOP

LIGHT CAVALRY REGIMENT

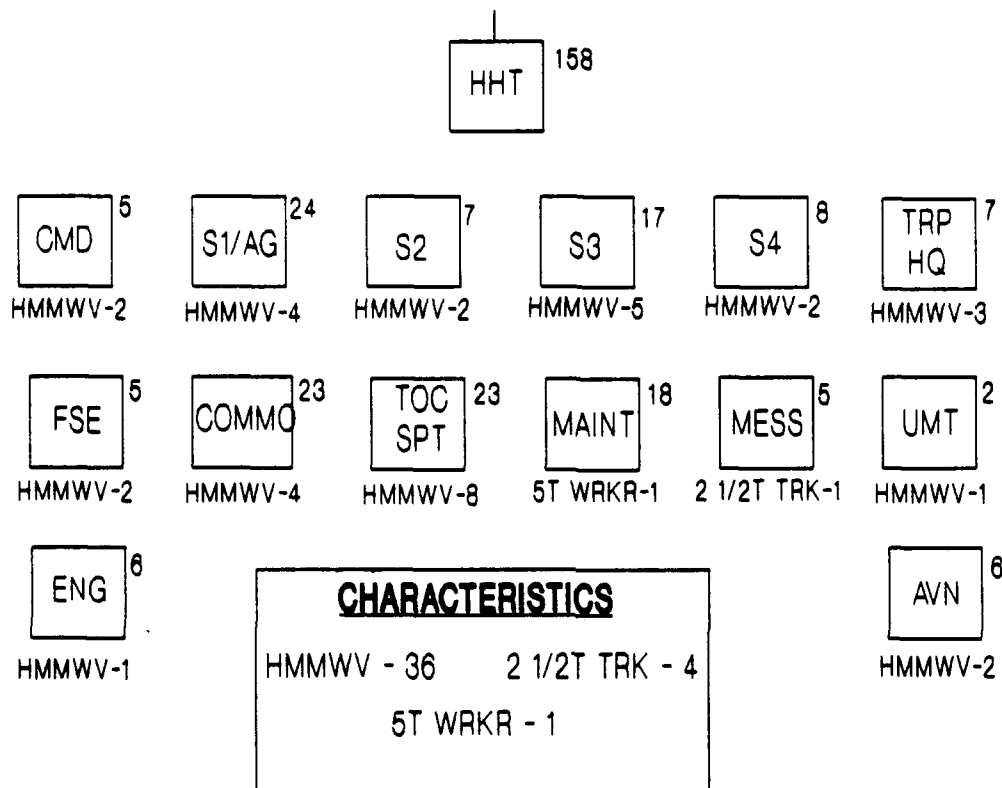


Figure 4 This figure depicts the Headquarters element of the LCR equipped primarily with HMMWV variant vehicles. The HHTs for the squadrons would be similarly equipped.

LIMITATIONS

The primary limitation to the study is that it will compare and analyze only four vehicles or systems which are already type classified and currently in the U.S. Army inventory. A type classified vehicle or system is one which

LIGHT CAVALRY SQUADRON

LIGHT CAVALRY REGIMENT

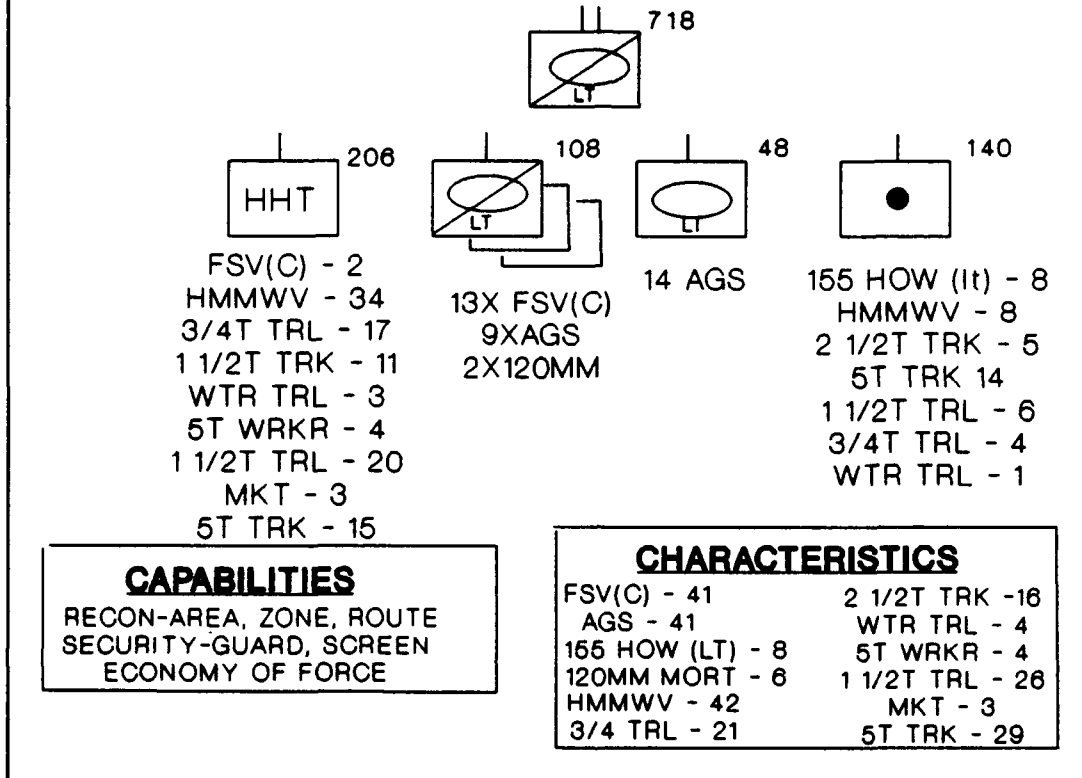


Figure 5 This figure shows the proposed organization and primary equipment for the light cavalry squadron.

has already been tested to meet the standards of operation as set by acquisition guidelines and requirements documents. In discussing this thesis topic with personnel of the Command and Control Directorate of the Combined Arms Center, upwards of 24 different variants were proposed for inclusion into this study. The four selected for this study were based on the following criteria: currently type classified; already (or partially) fielded; availability of historical and

basic descriptive data; and the ability to present that data without getting into the dilemma of presenting classified data.

The four variants which will be used as a basis for this study are as follows:

- M997 High Mobility Multipurpose Wheeled Vehicle
(HMMWV)
- M2A2/M3A2 Bradley Fighting Vehicle (BFV)
- M985 Heavy Expanded Mobility Tactical Truck (HEMTT)
w/Shelter (Standardized Integrated Command
Post,[SICPS]) [also known as the Functional CP]
- FOX NBC Recon Vehicle (TPz FUCHS) 6X6

Thesis Outline

The remaining chapters of the thesis are described below.

Chapter 2: Literature Review. Chapter 2 will review the current types of light command posts already in use. In addition a list of documents will be presented with a brief summary of what information was pertinent for use in this study.

Chapter 3: Methodology. The general plan to meet objectives includes a listing of the various functional requirements of a command post vehicle and apply those elements in a matrix against four variants as candidates for a future command post vehicle. Assumptions and the parameters

of the study are presented. A survey was conducted to determine the 'weighting' of criteria for the decision support matrix. A recommendation will be made based on the matrix.

Chapter 4: Analysis. Chapter 4 will present a general discussion of the operational characteristics of each of the candidate vehicles. Each vehicle will be discussed separately first in regard to the scope, limitations, and parameters previously mentioned. A short discussion will disclose the rationale for assignment of base scores in the comparison matrix prior to the application of weighted criteria.

Chapter 5: Conclusion. The conclusion from this study is be to recommend a command and control vehicle for the LCR that is best equipped for the command and control missions that a LCR may be tasked to perform as part of a contingency corps with global contingencies. Future army units will have to be highly flexible in their ability to focus on a large number of different types of threat and environments. This study will provide the basis for the command post base vehicle.

CHAPTER 2

LITERATURE REVIEW

The purpose of the literature review is to present other information relative to the problem and to present information sources and research information which are used in the completion of this study. Having completed research, the data collected will be applied to a selected methodology which results in formulation of a conclusion and recommendation.

For the purposes of this study I will first present some examples of a current light brigade size command post.

Secondly, I will summarize the research and information sources which I used in the comparison of selected variants.

Other Current "Light Command Posts"

U.S. Army Light Infantry Division

A command post currently in existence which most closely models the apparent needs of a future light cavalry regiment is the command post organization of a brigade in a light infantry division. Researching this type of command

post indicates that it is probably the least mobile of all current Army brigade size command posts. The primary shelter is based on tentage, and is immobile once setup. This system is unsatisfactory for a cavalry organization. The following figures are extracts from the 2nd Brigade, 7th Infantry Division Tactical Standard Operating Procedure which shows the setup, configuration and equipment placement of the brigade TAC and TOC. Figure 1 shows the setup for the TAC.

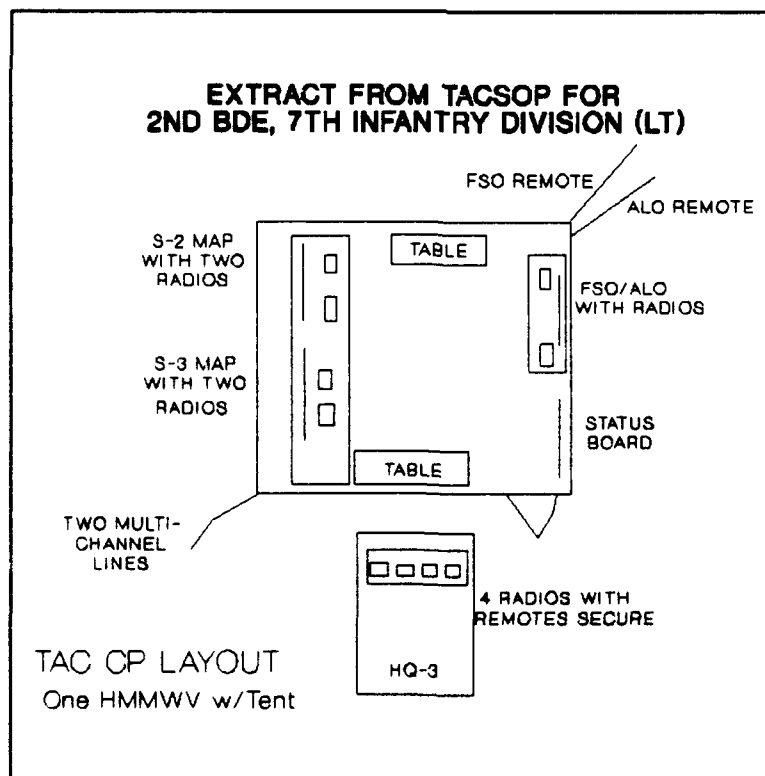


Figure 1 This diagram depicts the layout of a Light Infantry Division Forward Command Post (TAC CP).

This command post configuration is transported by HMMWVs and 3/4 ton trailers. It has little capability to function on the move. This type of setup suffices for the light infantry brigade. Once the brigade is in place on the ground it is relatively immobile so there is not a requirement for a mobile C2 capability. This CP is based primarily on the expandable tent version of the Standardized Integrated Command Post (SICPS).

Figure 2 depicts the TOC operation which again is totally housed in expandable tents.

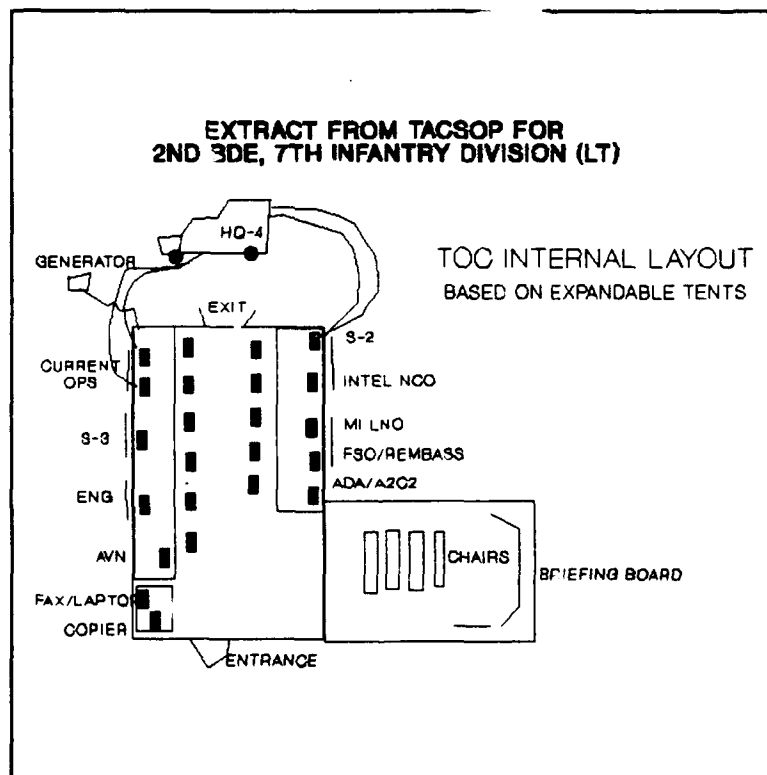


Figure 2 This figure depicts the layout of a Light Infantry Division Main Command Post.

The Marine Command Post

The Marine Corps Mechanized Combined Arms Task Force (MCATF) is built around battalion size maneuver elements. Armor and infantry units comprise the task force, dependent upon the mission and area of operations.¹ This force has a mission profile similiar to missions that the LCR is expected to carry out. The MCATF is a force which is expected to conduct contingency operations in any part of the world on short notice. For that reason it is interesting to conduct a short review of the MCATF's command and control structure and procedures.

A regimental-sized MCATF will consist of at least two battalion-sized maneuver elements. The principle forces of a MCATF are tanks, infantry mounted in amphibious assault vehicles (AAVs) and artillery.

The command and control element for a MCATF is made up of six principle vehicles, two Assault Amphibian Personnel and Cargo Carriers (LVTP-7), two Assault Amphibious Command Vehicles (LVTC-7), and two HMMWVs. This arrangement gives the command group the capability to operate as two separate command groups designated as the ALPHA Command Group and the BRAVO Command Group. Each group is made up of three vehicles. A LVTC-7 is the primary vehicle. The LVTP-7 and HMMWV carry personnel and equipment as shown on the following page.

¹Marine Corps Institute, Mechanized Operations, Amphibious Warfare School, Marine Barracks, Washington, D.C., MCI 7509B, 1983, p 2.

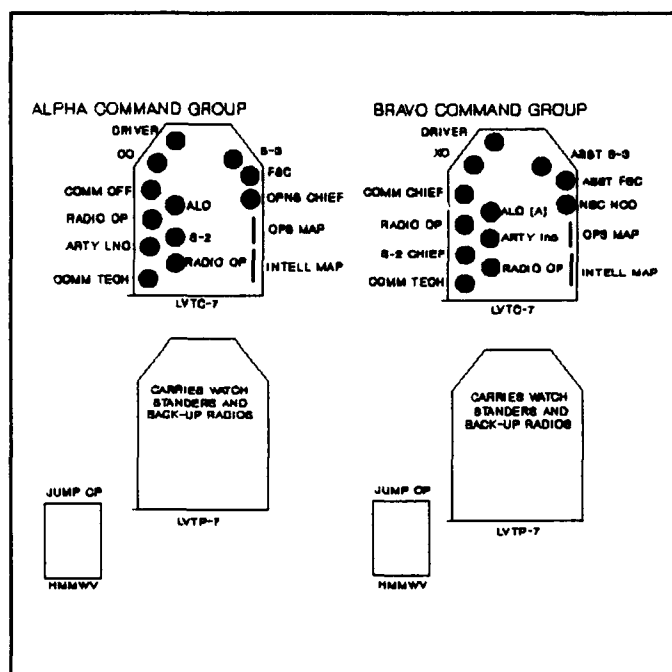


Figure 3 MCATF Command and Control Elements

In the offense the Bravo group follows the Alpha group at a distance. In the defense, the Alpha and Bravo command groups locate in close proximity to each other to allow establishment of a combined watch section.²

Data on the LVTC-7 and LVTP-7 is as follows:

	LVTC-7	LVTP-7
Combat Weight	42.2K	51.9K
Max Speed, Land	40 mph	40 mph
Max Speed, Water	8.4 mph	8.4 mph
Range	300 mi	300 mi
Height	114 in	122 in
Maximum trench X-ing	96 in	96 in

²Ibid., p 19.

Both vehicles have approximately 462 cubic foot of space in the cargo/troop compartment area (14ft X 5.5ft X 6ft).

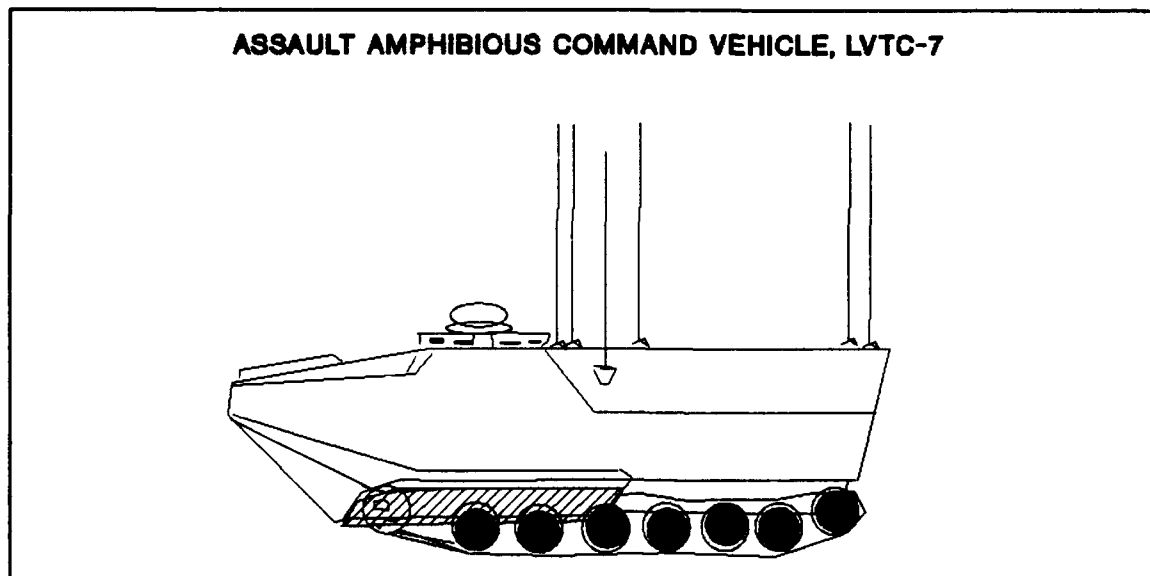


Figure 4 This a silhouette view of the LVTC-7 vehicle used by the U.S. Marine Corps as a command post vehicle.

In units equipped with the LAV-25 the LAV Command and Control variant is used. A discussion on this vehicle can be found in Appendix 2.

Research and Information Sources

The US Army Armor Center and Fort Knox published a report (May 91) which lays out the broad base design of the future LCR. Little has been mentioned regarding the design of the headquarters element of the LCR and the type of vehicle that will comprise the command post. Major General Thomas Foley, Commanding General of the U.S. Army Armor Center and Fort Knox discusses these concepts in Armor 2000 - A Balanced

Force for the Army of the Future. The Combat Development Branch of the Combined Arms Center (CAC-CD) has some studies which were completed during the mid-1980s that dealt primarily with the design of a light armor battalion and the CS\CSS units required to support it. A concept test for improving command and control was also conducted in between 1986 and 1987 by Fort Knox. This test was titled, Command and Control Vehicle Concept Program - Command and Control Enhancements Force Development Testing and Experimentation. The results of this test discuss the application of various modifications to the M1 tank, Bradley Fighting Vehicle, the M577 Command Post Carrier, and the M1009 Commercial Utility Cargo Vehicle. Many of the findings were useful in the selection of the four variants used in this study.

The results from a report entitled Division Command Post Test conducted at Fort Hood in 1975 also provided insights as why there is a need for better mobility, and survivability in CP design.

A few published monographs from the School of Advanced Military Studies at Fort Leavenworth provided information discussing the doctrinal shortfalls in command and control of reconnaissance missions of armored cavalry.

Approximately 25 works have been identified by the Combined Arms Research Library that discuss aspects of the structure of command and control systems at the tactical level. These works do not address the issue of command and

control vehicle variants directly, but serve as background material in command post operation and the information needs of the commander and staff.

Several Jane's series books on combat vehicles, combat support vehicles and command and control systems were very helpful in providing some of the basic data used in comparing the variants.

Current MTOEs and after action reports that discuss the organization, manning and deployment of the "light" and "airborne" command posts are available at the U.S. Army's Center for Army Lessons Learned (CALL). The Desert Storm Special Study Project Archives have a variety of reports which discuss operational problems of the two armored cavalry regiments deployed during Operation Desert Storm. These monographs, MTOE designs as provided by Combined Arms Center, Combat Developments (CAC-CD), as well as reports from Desert Storm provide the basis for analysis in order to identify operational shortfalls and discuss possible solutions.

The technical data for this study was extracted from a variety of U.S. Army Technical Manuals (TMs) which were available for each of the specific vehicle variants.

Reports from various units participating in Desert Storm, briefing packages on Desert Storm and emerging insights from the Total Armor Force Management Office at Fort Knox were key to the focus of this study.

Marine technical bulletins and the manufacturer's

Operator Handbook for the LAV-25 dated 30 May 1984 were helpful in the development of the information presented in Appendix 2.

Finally, technical information provided by the Army Material Command (AMC), and the FMC Corporation in the form of fact sheets and information papers on the Standardized Integrated Command Posts (SICPs) and the German FUCHS vehicle were key to two of the variants used in this study.

CHAPTER 3

METHODOLOGY

It is a truth beyond argument that full and accurate information becomes most vital at the point of impact, for unless it is correctly applied there, the wisest plans of the ablest general will likely fail.¹

S.L.A. Marshall

The methodology used in this study is primarily a comparison of four different vehicle variants for use in the C2 role of a Light Cavalry Regiment (LCR). Comparative matrixes were obtained from the Army Acquisition Course at the U.S. Army Logistics Management College at Fort Lee which were used in the selection of vehicles during the Army acquisition process.

The process of my research and analysis is as follows:

1. Determination of a problem or information void.
2. Statement of research problem.

¹Marshall, S.L.A., Men Against Fire, Washington: Infantry Journal, 1947, quote is attributed to this work.

3. Determination that the problem is appropriate for the decision matrix approach.
4. Selection of decision matrix criteria and sub-criteria.
5. Application of vehicle data and characteristics to various matrixes.
6. Justification for data used or not used or lack of data.
7. Computation of matrix scores.
8. Comparison of matrix scores in a final decision matrix.
9. Conclusion and recommendation based on final matrix results.²

Methodology Criteria Definitions

In this study I will use the following criteria to conduct the comparative analysis of the four variants.

Mobility = a comparison of speed, water crossing capability, height obstacle capability, and range.

Survivability = NBC protection, spall protection.

User Oriented = square footage of work area, reliability, availability of an "on-board" power supply.

Deployability = ease of preparation and ease of loading into air and sea transports, height and combat weight.

Compatibility = capability to accept current C2 systems (i.e., communication and battle maneuver systems) with or without modification.

²Fox, David J. The Research Process in Education, Holt, Rinehart and Winston, Inc., New York, 1976, p 448.

Cost = a comparison of purchase price of each vehicle.

Methodology Model

The capabilities of each variant will be compared in a matrix. Each of the main categories are further subdivided into sub-categories. Figure 1 below represents the model used. Each variant will be applied to this model. By grouping weighted scores, each variant is rank ordered by best to worst against each of the five main criteria. Other comparison factors were not applied.

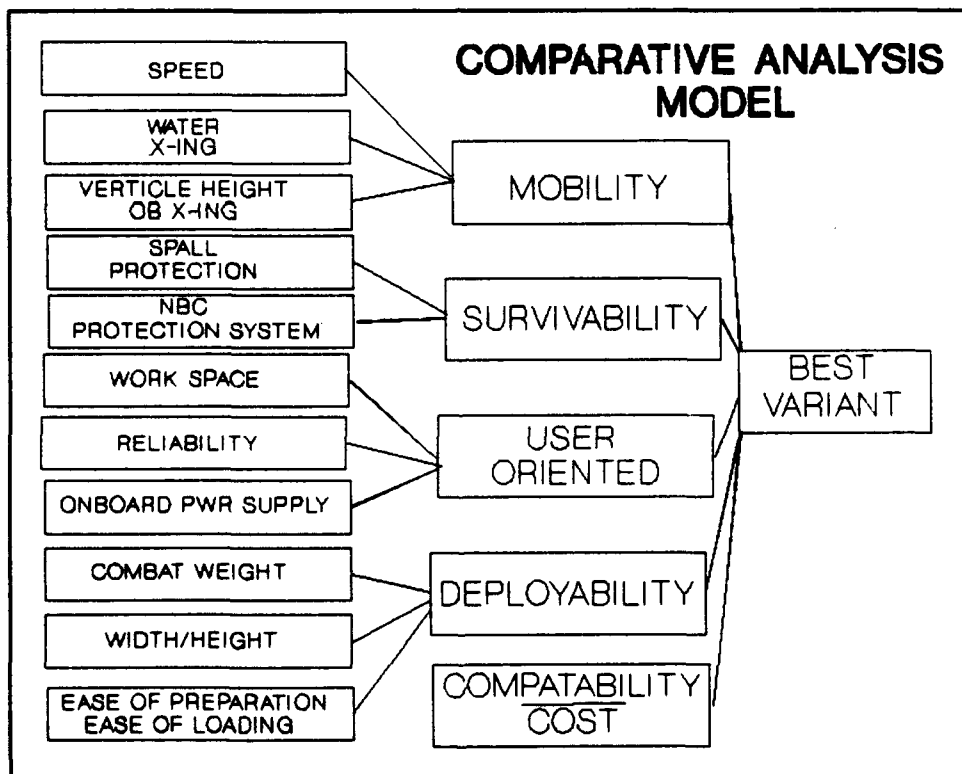


Figure 1 This model shows how the different sub-criteria support the five main criteria used to compare the variants in this study.

The interval scale applied to this model is depicted in Figure 2. For the purposes of this study a "higher" score is better when considering the "weighting" used and the overall final scores.

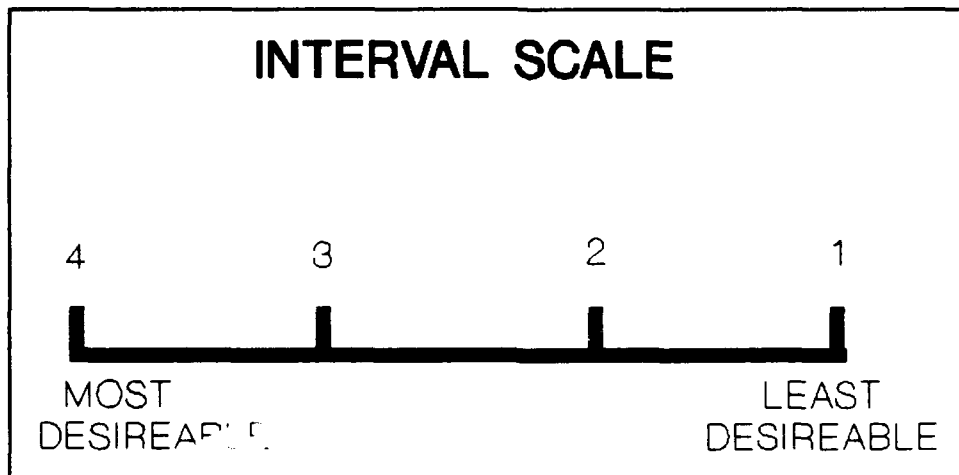


Figure 2 This scale shows that higher numbers are more desirable when used in the decision matrixes of this study.

Weighting Criteria

The criteria used in this study are derived from a number of sources. FM 100-5, our U.S. Army doctrine on military operations, states that command and control must "promote such flexibility and freedom to operate independently...and ...must permit tactical leaders to position themselves wherever the situation calls"³ In 1984, then Chief of Staff of the Army, General John Wickum, in addressing the equipping of light forces stated, "Lightweight, securable, anti-jam, interoperable communications equipment

³FM 100-5 Operations, Headquarters, Dept of the Army, May 1986, pp 22-23.

will be needed to support decentralized, independent operations. Appropriate design criteria will include: light, high mobility vehicles, high reliability...and longer range."⁴

These sources and others drove the selection of the five main criteria listed in Figure 1. A survey was conducted at Fort Leavenworth, among staff college students and faculty, in January of 1992, to determine which of the five criteria were most important to users in the field. (See Appendix 1 Sample Survey.) Combat arms, combat support and combat service support officers who had experience in our current C2 vehicles were asked to rank order from "most important" to "least important" the five major criteria while comparing their application to a possible future command and control vehicle. The results of this poll will be discussed in Chapter 5.

⁴Chief of Staff, US Army, White Paper 1984, Light Infantry Divisions, Headquarters, Dept of the Army, Washington, D.C., May 1984, p 5.

CHAPTER 4

ANALYSIS OF SELECTED VARIANTS

In this chapter the effectiveness and potential utility of each of the four command and control variants will be assessed. The assessment of each vehicle variant will be preceded by a technical description of the variant and a listing of it's various capabilities.

Assessment will be performed by comparing the variants in a series of matrixes as explained in Chapter 3. After each of the variants have been analyzed and a base score determined, the final step will be to combine the base score for each of the variants into a final decision matrix. The vehicle with the best overall score will provide the basis for final recommendation and conclusions.

Vehicle Descriptions and Capabilities

The HMMWV Variant

The High Mobility Multipurpose Wheeled Vehicle or HMMWV has a number of models which were considered for the purpose of this study. Communication variants are already

fielded extensively throughout the Army which consist of a S-250 Shelter mounted on the back of the M1037 or M1042 model HMMWV. The only difference between these two models is a winch mounted on the front of the M1042 model. Currently, the S-250 Shelters are equipped to function as switchboards, or Subscriber Entry Point nodes (SENS nodes) for the Multiple Subscriber Network (MSE). This model was not selected because the shelter currently is not equipped with an NBC system nor is there a kit available to increase ballistic protection.¹

The best HMMWV model for this study is the M997 HMMWV Ambulance (See diagram below). It provides the largest working area of all the HMMWV models. The M977 is

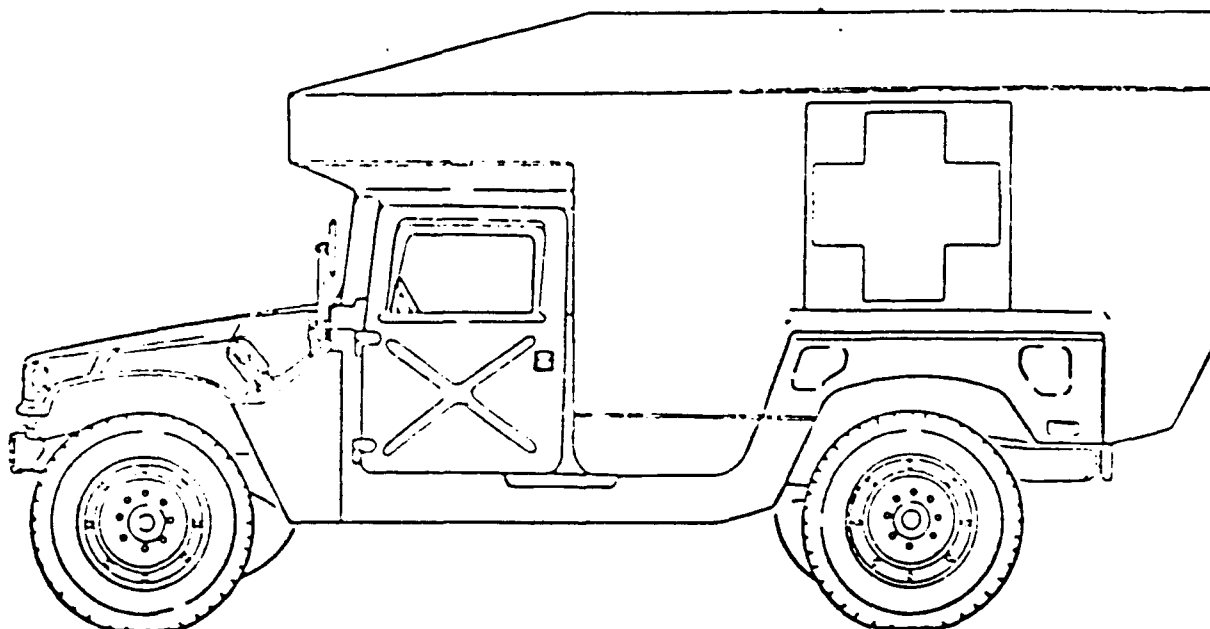


Figure 1 The M997 HMMWV Maxi-Ambulance.

¹Public Affairs Fact Sheet, Subject: Army Standard Family of Rigid Wall Tactical ISO Shelters, U.S. Army Natick Research, Development and Engineering Center, Nov 91.

equipped with a NBC gas-particulate system and air conditioning system. The current ambulance body is made of the same kevlar material found in the standard armored HMMWV body. This kevlar body provides limited protection from shrapnel and small arms penetration.

HMMWV Description

The HMMWV is a four wheel vehicle which has a drive train in the midships position allowing the front differential to be raised. This, together with the geared hubs, provides a ground clearance of 24 inches. To reduce life cycle and initial procurement costs, standard automotive components are used wherever possible, as in the engine, transmission, transfer case, brakes and steering.

The independent suspension, front and rear, gives good maneuverability, ease of handling and part commonality. The geared hubs give .406m all-round ground clearance incorporating raised axles for high speed operations on road and cross country. The hubs also provide a 1.92:1 torque output multiplication at the ground.

The HMMWV will accelerate from a standstill to 48 km/h in seven seconds and from a standstill to 80 km/h in 20 seconds. Three HMMWVs can be carried in a C-130 Hercules transport aircraft, six in a C-141B and 15 in a C-5A

The M997 Armored 4-Litter Ambulance can operate in an NBC environment and is equipped with a Gas-Particulate Filter Unit (GPFU) capable of supporting up to seven personnel. The GPFU forces temperature controlled, filtered air to the mask facepieces, which increases protection, eases breathing, and reduces stress and heat fatigue during extended periods of NBC operation.³

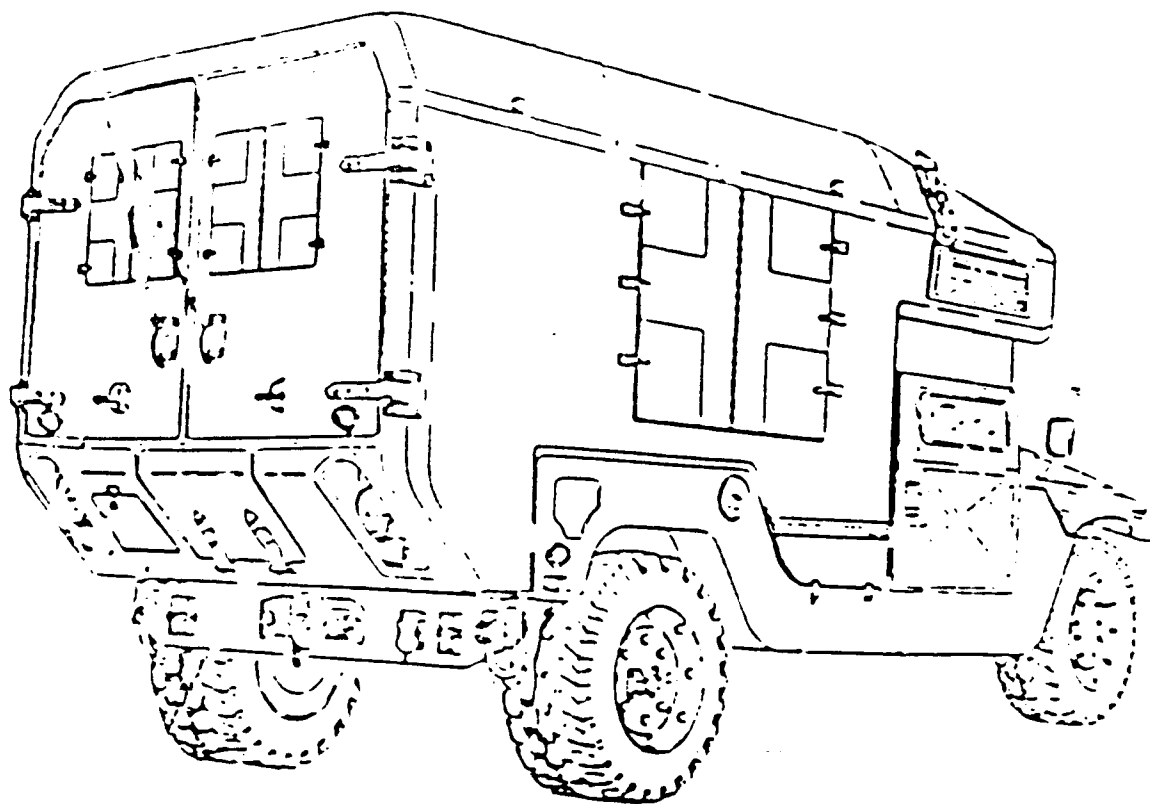


Figure 2 Right rear view of the Maxi-Ambulance.

³TM 9-2320-280-10, Change 2, Ambulance, 4-Litter, Armored, M997, Oct 1987, p 1-16/18.

The HEMTT Variant

The Heavy Expanded Mobility Tactical Truck (8 X 8) or HEMTT would not appear at first glance as a type of vehicle to consider for use as a command and control vehicle. My reason for selecting it is based solely on previous experience wherein a unit used a HEMTT and S-280 shelter as a squadron CP.

The S-280 shelter weighs 1400 pounds when empty. The external measurements of 12 feet, three inches length by seven feet, three inch width allow it to be easily mounted in the cargo box of the M977 Cargo version of the HEMTT. (See Figure 3 below)

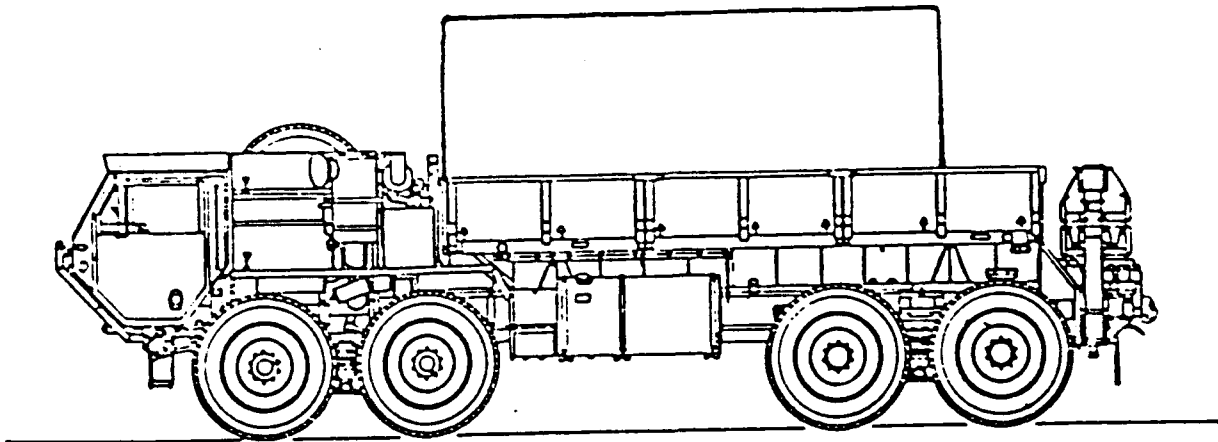


Figure 3 M977 Heavy Expanded Mobility Tactical Truck.

The cargo bed of the M977 is approximately 18 feet long and eight feet wide. The remaining cargo bed area is

used to mount a 3KW or 5KW generator (as an on-board power supply) and to carry the personal gear (TA-50) of on-board personnel.

Another feature is that the boom can be used as a quick deploying antenna by attaching two or three lengths of a normal antenna mast and the head and then raising the boom to the vertical position fully extended.

The current S-280 Shelter is capable of being shielded by the addition of a modification kit to provide at least 60db attenuation to electric and magnetic fields and to plane waves in the frequency range from 0.15MHz to 10,000MHz. Bolt on kevlar armor could be added to this shelter to increase ballistic protection.⁴

This type of shelter is currently in use by many units for electrical test and repair facilities and is normally mounted on the 5 ton series truck.

Development of these type of shelters has resulted in the recent fielding of a new series of containers which meet standards of "International Organization for Standardization" (ISO). These ISO shelters have exterior dimensions of eight feet by eight feet by 20 feet when in their transportation mode. These shelters are for use in

⁴Public Affairs Fact Sheet, Subject: Army Standard Family of Rigid Wall Tactical Shelters, S-280/G Shelter, U.S. Army Natick Research, Development and Engineering Center, Nov 91.

situations requiring highly mobile, environmentally controlled, work-in/live-in space.

The shelter panels are sandwich construction of nonmetallic honeycomb core thermally bonded with facings of aluminum skins which allow the users to mount hardware or equipment anywhere on the panels. Each shelter has built-in systems for three phase electrical distribution, internal fluorescent lights, an external area light and interface for external environmental control units. Each is equipped with leveling jacks and can be erected in the field without special tools. The shelter comes in three versions; nonexpandable (S-781 or S-782), one-side expandable (S-783 or S-784), or two side expandable (S-785 or S-786).

There are two model numbers of each type, the lower number designating a 60 amp system and the higher designating a 100 amp system. The nonexpandable version has an empty weight of 3,900 pounds and a floor area of 145

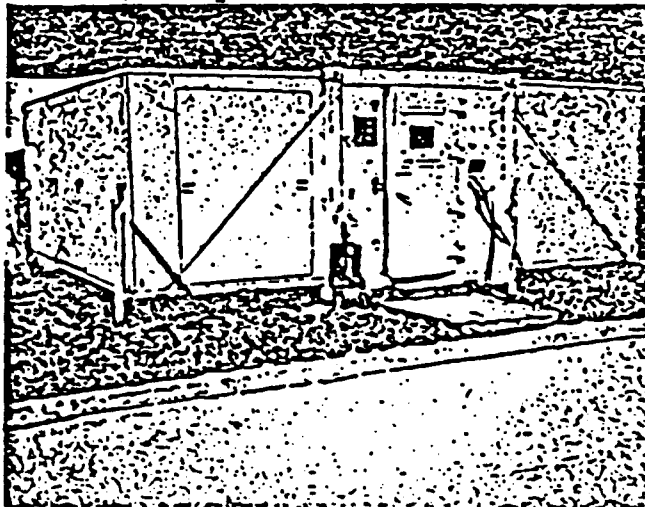


Figure 4 S-783/S-784, S-785/S-786 Expandable Shelter.

expandable models weigh 6,900 pounds and have a floor area of 390 square feet. (See Figure 4).

U.S. Army Natick RD&E Center is further developing the functional capacities of these shelters by developing connecting passageways, hardwall extension kits. To further enhance capabilities upgrades are available to counter specific threats which include chemical protection, electromagnetic interference (EMI) protection, electromagnetic pulse (EMP) protection, ballistic protection, and blast and thermal protection.⁵

No reference was found to substantiate whether or not one of the new ISO shelters had ever been mounted on the bed of a HEMTT M977. The overall length of the ISO shelter (20 feet) exceeds the current bed length (18 feet) of the M977. However, this additional length could be accommodated by removing the front and rear cargo bed side wall panels and dismounting the boom assembly. Available power telescoping antennas could be used in lieu of the boom assembly for antenna erection.

Due to the increased potential for protection, increased work area, and expansion this type of shelter provides, I determined the HEMTT vehicle would be a solid candidate for a command and control vehicle if it carries one of the new ISO shelters. Even with the smaller S-280

⁵Public Affairs Fact Sheet, Subject: Army Standard Family of Rigid Wall Tactical ISO Shelters, U.S. Army Natick Research, Development and Engineering Center, Nov 91.

candidate for a command and control vehicle if it carries one of the new ISO shelters. Even with the smaller S-280 model shelter, the HEMTT is a solid option.

For the purposes of this study the HEMTT C2 variant will be considered to be carrying Non-expandable S782/G (100 amp) shelter. Although the larger work area provided by one of the expanding versions would have been preferred, the non-expanding models were chosen, due to the need to restrict weight wherever possible.

HEMMT Description

The first prototype for the HEMTT was completed in December of 1981 as a replacement for the M520 GOER. The first production vehicles were delivered in September of 1982. The vehicle makes extensive use of standard commercial automotive components including an Oshkosh truck cab, standard eight-cylinder diesel engine and a standard four-speed automatic transmission.

The chassis is formed of channel bolted construction with heavy duty front bumper and skid plate, external hydraulic connection, service and emergency air brake connection, slave start connection and trailer electrical connector. (See front below and rear view Figure 5 and 6, respectively.)

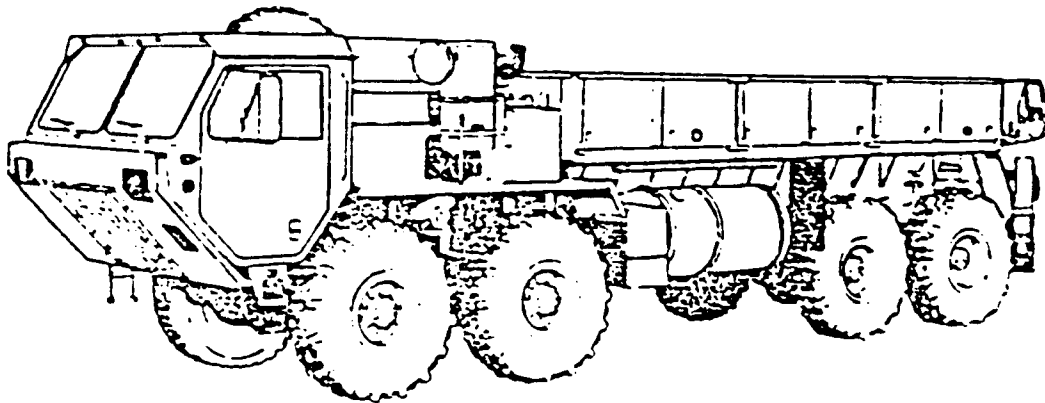


Figure 5 M977 Left Front View.

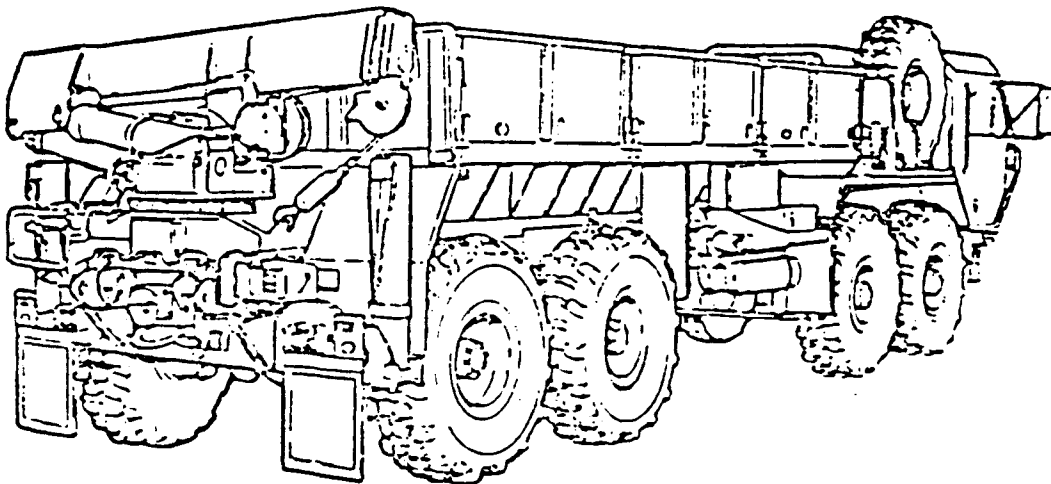


Figure 6 M977 Right Rear View.

The rear axles are Eaton DS-480 single reduction type with driver controlled differential. The engine is a

Detroit Diesel 8V-92TA, V-8, 2 stroke, 12.06 liter diesel developing 445 hp at 2100 rpm. The M977 Cargo truck is the basic member of the HEMTT series with a light duty material handling crane at the very rear. The cargo area is 18 feet long with drop sides.⁶

The BRADLEY Variant

The M2/M3 Bradley Fighting Vehicle is already in use by a number of units as a command and control vehicle. During the author's tenure in the 11th Armored Cavalry Regiment in Europe and the 3rd Armored Cavalry Regiment in Operation Desert Storm both of the command groups contained Bradleys which had been altered to fill the C2 role. Alterations included the removal of the TOW missile storage racks from the right inside rear of the crew compartment (to accommodate mounting of map boards), additional lighting, the mounting of three additional radio mounts along the left inner wall, and replacement of the two/four crewmen seats with swivel pedestal chairs (from an M88A1 Recovery Vehicle). In addition, a small commercial DC power generator was mounted on the right rear of the hull to provide an on-board power supply.

⁶Jane's Military Logistics, Jane's Information Group, New York, 1989, p 541-542.

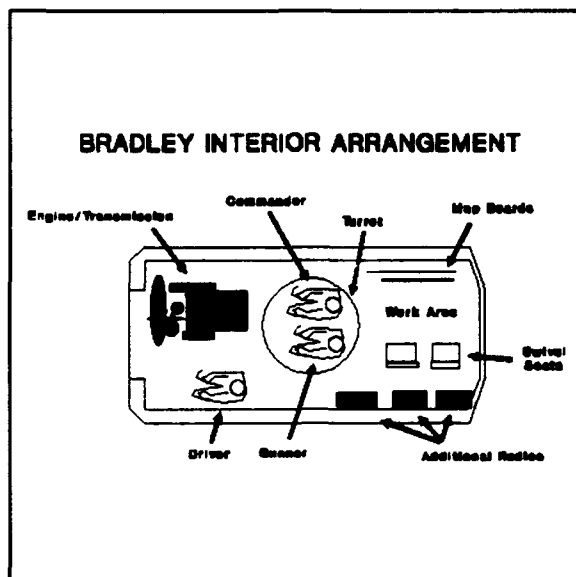


Figure 7 BRADLEY top view and interior arrangement.

Of all the variants considered in this study, the Bradley is the most heavily armed and most capable of providing the LCR and subordinate squadron commanders a command and control vehicle with the best self-defense capability.

BRADLEY Description

The first production Bradley Fighting Vehicles were delivered to the Army in July of 1982. The hull of the fighting vehicle is made of all-welded aluminum armor with spaced laminate armor fitted to the hull, sides and rear.

The driver sits at the front of the vehicle on the left and has a single piece hatch cover. Periscopes provide the driver with vision while the hatch is secured. The center front periscope can be replaced by an AN/VVS-2

passive night periscope for night operations. The engine compartment is to the right of the driver and houses a Cummins VTA A-903T turbo-charged 8-cylinder diesel developing 500 hp at 2600 rpm (newer models develop 600 hp).

The engine is coupled to a General Electric HMPT-500 hydro-mechanical transmission that has three different speed ranges. The vehicle has a Halon fixed fire extinguisher system. Main armament consists of a McDonnell Douglas Helicopter Company M242 25mm Chain Gun with a 7.62 M240C machine gun mounted coaxially to the right of the main gun. The 25mm cannon is dual feed and the gunner can select single shots, 100 or 200 rpm rates of fire.

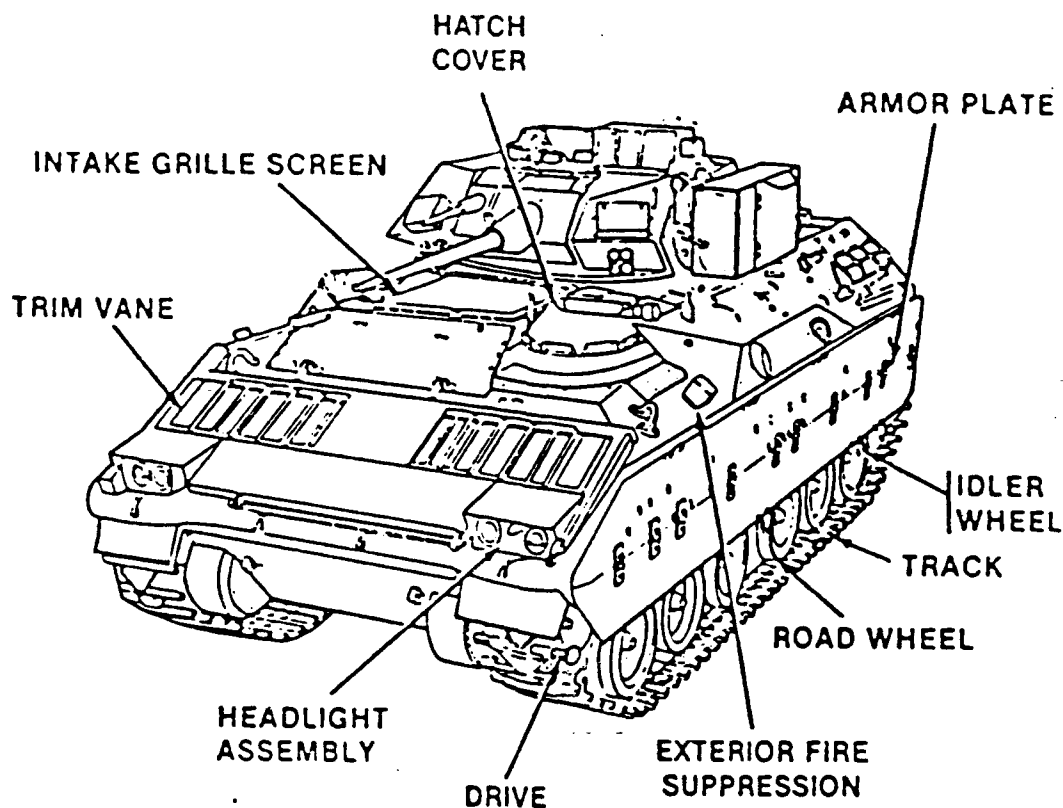


Figure 8 Left front view of the M2/M3 BRADLEY vehicle.

The turret has a 360-degree electric traverse and the weapons can be elevated from -10 to +60 degrees. Mounted on the gunners side of the vehicle is the TOW sub-system. A single-piece hatch cover that opens to the rear is located over the troop compartment. On the rear of the vehicle is a large hydraulically operated ramp which has an integral door in the left side.

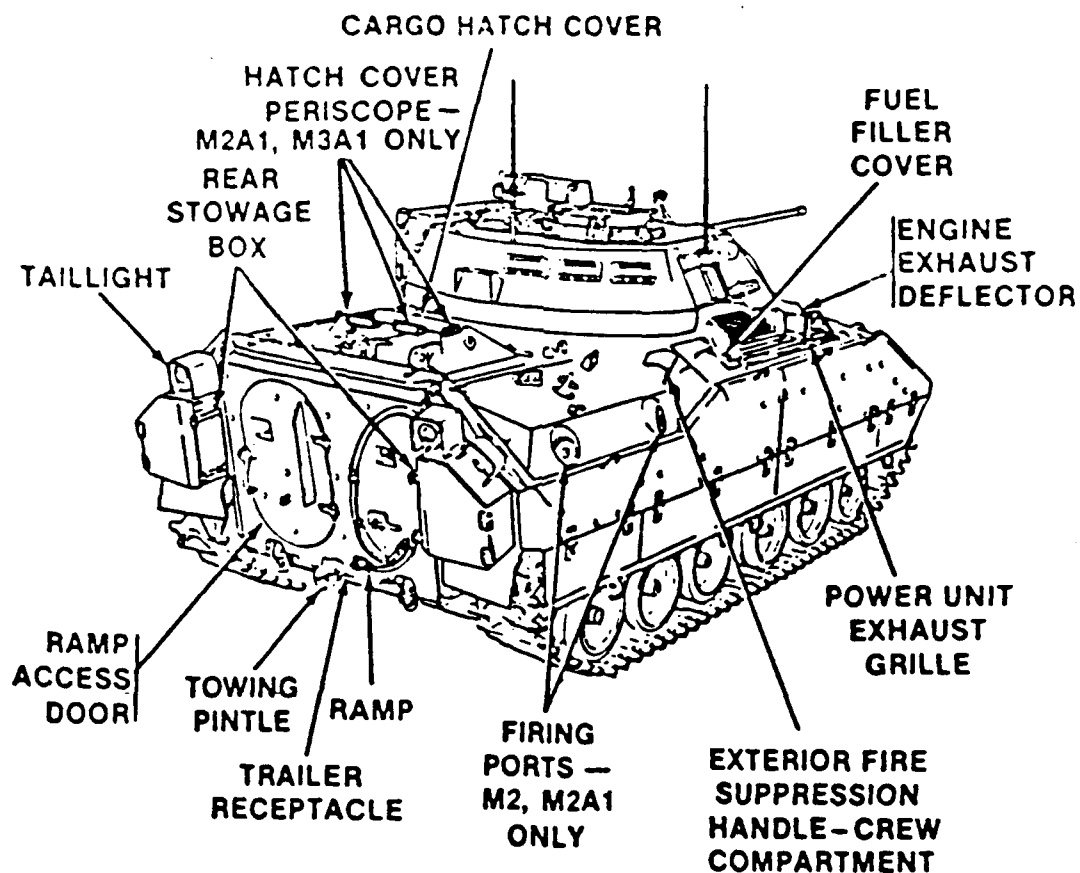


Figure 9 Right rear view of the M2/M3 BRADLEY vehicle.

The Bradley has a central gas particulate filter system for the commander, gunner and driver, but personnel

in the rear compartment have to wear individual protective masks. The Bradley does not have an over-pressure system.

The Bradley is fully amphibious being propelled in the water by its tracks. Preparation time is required prior to swimming the vehicle in order to erect a water barrier which is normally stowed in a rolled position along the top of the side skirts. The application of additional armor protection makes the Bradley too heavy for the current flotation curtain. (See Figure 10 below of a Bradley with the Water Barrier erected).

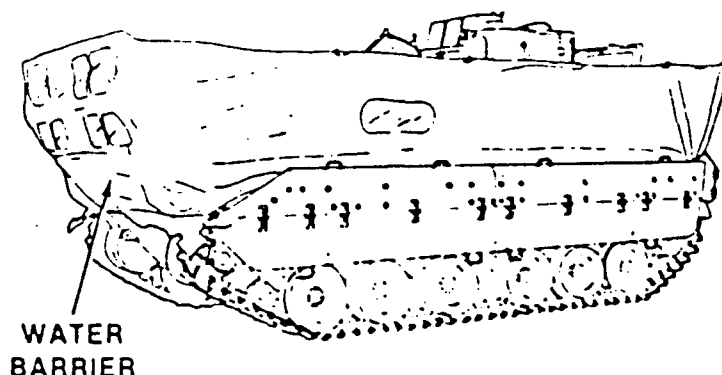


Figure 10 BRADLEY vehicle with swim barrier erected.

The Bradley is air transportable in the C-141 and C5A however, when being airlifted in the C-141 Starlifter the head of the gunner's integral sight and the skirt plates are removed and all road arm positions (6 on each side) are snubbed in the up position using steel cables. Although the combat weight of the Bradley M3A2 is 66,000 pounds it can be reduced to 44,000 pounds for air transport by the removal of the add-on armor and side skirting.

and revised ammunition stowage. Other improvements are planned. Tests have been underway at the U.S. Army Materials Technology Laboratory (MTL) since September of 1986 for the construction of a molded thick laminate composite (reinforced plastic) hull based on the Bradley chassis.⁷

The FUCHS Variant

Of the four variants in this study, only the FUCHS Transportpanzer 1, (Armored Personnel Carrier), was specifically developed as a command and control vehicle. The U.S. Army does not have this model in its inventory. Since 1989, the U.S. Army has purchased a number of the FUCHS vehicles but only of the NBC Reconnaissance version, known in the U.S. Army's nomenclature as the NBC Reconnaissance System (NBCRS or FUCHS NBCRS) or as the "FOX". The NBCRS is an integrated system capable of detecting, identifying, and marking areas of nuclear, biological, and chemical contamination.⁸

The German Army designation for the FUCHS C2 version is the FueFu (FUCHS + Fuhre [for commander or leader]). The vehicle has a 5kw generator in the left wing of the rear

⁷Jane's Armour and Artillery, 1988-89, Jane's Information Group, New York, 1988, p 396-400.

⁸Matthews, George F., Initial Transportability Engineering Analysis of the Nuclear-Biological-Chemical Reconnaissance System (NBCRS) FUCHS TPZ1 Version, Military Traffic Management Command, Nov 1986, p 1.

is the FueFu (FUCHS + Fuhre [for commander or leader]). The vehicle has a 5kw generator in the left wing of the rear door. Fuel for this generator is supplied from the main tank.

Communications equipment, map board, two folding tables with personnel lamps, three folding seats and a box with a padded seat are also available. Up to four antennas can be fitted, including a very high one at the right rear of the hull.

FUCHS Description

The all-welded steel hull of the FUCHS protects the crew from small arms fire and shell splinters and spall. The hull has a rhomboid cross section and incorporates spaced armor in critical areas.

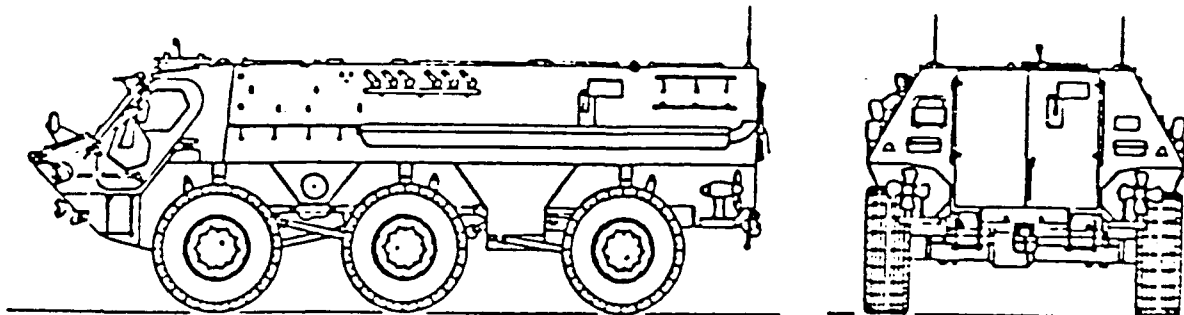


Figure 11 The FUCHS vehicle.

The driver sits at the front of the hull on the left and the vehicle commander on his right. A large bullet-

proof windscreen to their front can be covered by an armored shutter hinged at the top. There are four periscopes fitted to the drivers roof hatch and the center one can be replaced by a passive periscope for night operations.

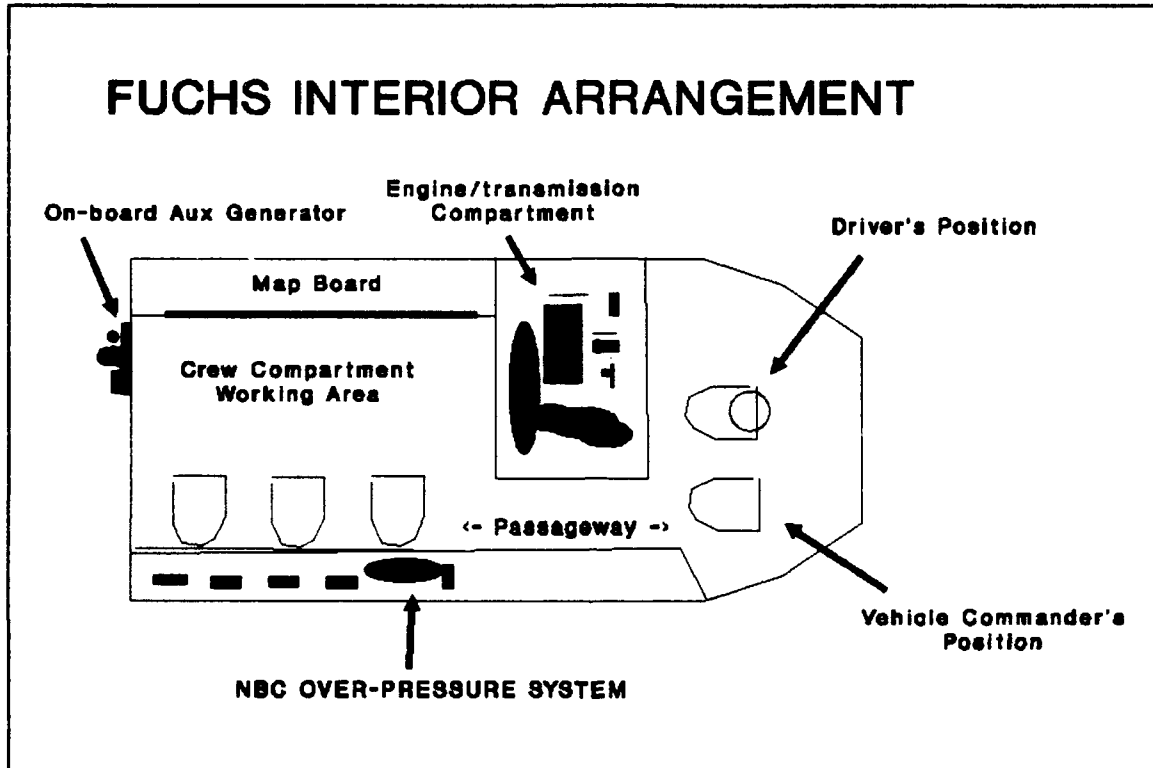


Figure 12 This diagram presents an over-head view of the FUCHS vehicle. The driver and commander are situated forward.

The engine compartment is located behind the driver and contains an eight-cylinder Mercedes-Benz OM 402A exhaust turbo-charged, liquid cooled, diesel developing 320 hp at 2500 rpm. The transmission is a ZF model HP 500 6-speed automatic.

The transporter is fully amphibious being propelled

by two four-blade propellers beneath the floor level of the vehicle at the rear of the hull. The propellers can be traversed through 360 degrees to provide steering. Nominal amphibious payload is 4410 pounds.

The vehicle has a NBC over-pressure system, which can ventilate both the crew and personnel compartments. One export variant of this vehicle does have the ability to air condition the crew and driver compartment. The vehicle can mount a 7.62 over the commanders hatch ring or a 20mm Rheinmetall cannon over the first circular roof hatch of the crew compartment.⁹

The cargo compartment has up to 19.6 square feet. protection system, heaters, batteries and radio equipment are fitted on top of the wheel housing to save space.

⁹Jane's Armour and Artillery, 1988-89, Jane's Information Group, New York, 1988, p 296-298.

Comparison of the Four Variants

The definitions of the five criteria used for analysis of the variants are important to understand. The definitions as they are used in this study are presented in the following paragraphs. In completing this study efforts were made to ensure the material presented was clear, concise and unclassified. Some of the criteria lend themselves to easy complication by continually adding on sub-criteria and related data. In this study each of the five main criteria are divided into no more than four sub-criteria.

In using the decision matrixes, it was decided initially that higher numbers would be better for the scoring process. Each of the vehicles performance data for each criteria was entered into the matrix and a score assigned based on comparison. A "one" is the lowest score possible in each category and a "four" is the highest. In the event that two vehicles had the same performance data in any given category, they were both assigned the same score in descending order with the other variants.

Mobility

The first area of comparison is mobility. This criteria is made up of four sub-criteria. The sub-criteria are: range, maximum speed capability, maximum water fording

capability and height obstacle crossing capability.

The definitions used in this study for each of the four sub-categories are as follows:

--range = the average number of miles that the vehicle can travel over level paved surface roads on one tank of fuel.

--maximum speed capability = the maximum sustained forward speed on a flat paved surface road.

--maximum water fording capability = the maximum depth of water that the vehicle can negotiate (expressed in inches). If a fording kit or swim kit is used it is noted in the matrix.

--height obstacle crossing capability = the maximum height of an obstacle that the vehicle can cross without hinderance. On the wheel vehicle variants it is expressed in the number of inches of clearance between the ground and the lowest portion of the vehicle (usually the axle). On the tracked variant it is the number of inches in height of an obstacle that the track can meet and drive the vehicle over (usually the distance between the ground and just below center on the lead road wheel or sprocket). Even though both the HMMWV and the Bradley rate a 24 inch height obstacle crossing capability the Bradley was given a higher matrix score because it has less tendancy to "high-center" on the obstacle because it is a tracked vehicle.

The application of the given data yields the results given in Figure 13 below.

MOBILITY MATRIX					
HIGHER IS BETTER					
	RANGE	MAX SPEED	WATER CROSSING	HEIGHT CROSSING	SCORE
		CAPABILITY	CAPABILITY	CAPABILITY	
HMMWV VARIANT 1	3 350	2 55	2 48 80 W/KIT	2 24	9
HEMTT VARIANT 2	2 300	2 55	1 48	4 30	9
BRADLEY VARIANT 3	2 300	3 57	3 SWIM W/PREP	3 24	11
FUCHS VARIANT 4	4 497	4 65	4 SWIM NO PREP	1 22	13
	MILES	MPH	INCHES	INCHES	

Figure 13 The FUCHS and Bradley are rated as best in mobility. Objectively speaking, the FUCHS rates best overall because of it's faster speed and swim capability.

Survivability

The survivability criteria of the vehicles is based on two sub-criteria, level of spall protection and NBC defense protection system (See Figure 2). Other factors which enter in the consideration are speed, height, thermal signature. For the purposes of this study only the two sub-criteria were evaluated.

Spall protection is defined as the capability of a vehicle to prevent penetration of the crew compartment either by projectiles or shell splinters and to prevent spall from injuring or killing the crew. Spall is the small pieces of the hull of the vehicle which rupture off of the inner surface of the hull as a result of impact by a projectile on the outer surface of the vehicle.

Protection against this type of fragmentation can be accomplished in three ways, increase the overall thickness of the hull; mount standoff armor on the outer surface of the vehicle; or mount a liner along the interior surfaces of the vehicle to stop the fragments from entering the crew compartment. Each of the variants considered had some type of protection against penetration but not all had protection against spall.

The method of measuring spall protection is generally expressed in terms of the size of projectile which the vehicle is protected against. Specific spall protection and penetration protection information is classified and will

not be included in the data considered for this study.

NBC over-pressure is a system which provides a positive air pressure in the interior portion of the vehicle. This air pressure is maintained by pumping outside air through a decontamination system and into the crew compartment. The crew does not have to wear gas masks for this system to be effective.

Older vehicle NBC systems include a gas-particulate system which is an air pump which forces air through a set of large filters mounted in the vehicle. The crewmen must wear their masks and connect a hose from their mask to the gas particulate system which provides them with clean decontaminated air.

The gas particulate system was not considered an over-pressure system in this study. Crew proficiency is degraded by having to operate while wearing gas masks, especially when hooked-up to this type of system by a hose.

SURVIVABILITY MATRIX

HIGHER IS BETTER

SCORE ACTUAL DATA

SPALL
PROTECTION

NBC
PROTECTION

SCORE

HMMWV VARIANT 1	1 NONE	3 NO	4 7 PLACE GAS PARTICULATE SYSTEM ONLY (FULL CREW)
HEMTT VARIANT 2	2 IN DEVELOP- MENT	2 YES	4 OVER-PRESSURE IN SICP SHELTER ONLY NOT FOR TC/DVR
BRADLEY VARIANT 3	4 UP TO 12.7 MM	1 NO	5 3 PLACE GAS PARTICULATE SYSTEM ONLY
FUCHS VARIANT 4	3 UP TO 7.62 MM	4 YES	7

Figure 14 The Bradley does have the capability to add-on additional armor which may make it superior in overall survivability. Adding on armor severely limits mobility and deployability.

Compatability/Cost

The compatibility and cost of each vehicle were treated as two criteria within the same matrix. Compatibility is defined as the capability of the vehicle to assume the command and control role without modification. The base cost of the vehicle is the approximate purchase cost of the vehicle in 1990 dollars.


COMPATABILITY / COST			
HIGHER IS BETTER			
			
	MODIFICATION REQUIRED		SCORE
	BASE VEHICLE COST		
HMMWV VARIANT 1	3 YES	4 35K	7 MINOR MOD REQ
HEMTT VARIANT 2	4 NO	3 160K+/-	7 SICPS not fully tested or fielded
BRADLEY VARIANT 3	3 YES	1 1.5M	4 MINOR MOD REQ
FUCHS VARIANT 4	3 NO	2 900K	5 Not fielded in US Army C2 configuration

Figure 15 Even though the HEMTT/SICPS and the FUCHS both have specific C2 designs, the HEMTT scores better than the FUCHS in required modifications because it is already partially fielded.

User Oriented

An important consideration in studying a command and control vehicle is whether or not the vehicle is "user friendly". This criteria was made up initially of three sub-criteria; cubic feet of work space, reliability, and whether or not the vehicle has an on-board power supply which can handle the expected power requirements without the operation of the main engine.

Reliability can still be regarded as questionable because I was not able to obtain the information on mean time between failures for the FUCHS variant. The numbers ranking on the matrix (see User Oriented Matrix) are simply my ranking of the vehicles based on my personal experience.

My rationale for the ranking is as follows. The HMMWV ranked as best overall because it represented a well tested vehicle which operated well and is not very complicated. The FUCHS as second best because of the reputation of German vehicles as being "the best Deutsche Marks can buy". In in the author's Desert Shield, Desert Storm experience, I never witnessed a FUCHS (NBCRS) FOX Recon vehicle go down for maintenance during an 8 month tour in Saudi Arabia. The HEMTT rated next to last due to the size and complexity of the vehicle and the unknown reliability characteristics of the Standardized Integrated Command Post (SICPs) unit. Finally, the Bradley ranked last

due to the fact that it is a tracked vehicle with maintenance that has historically been high on tracked vehicles.

The work space figures represent the cubic footage available in each of the variants. No clear dimensions were available for the Bradley, but using the author's experience, it is easily the smallest of the four on cubic footage available and thus rates a "one".

The on-board power supply is a feature near and dear to anyone who has ever had to wrestle with the 4.2kw generator or a towed 5-30kw trailer as part of the command post. This feature allows for greater mobility and ease of operation.

USER ORIENTED

HIGHER IS BETTER

SCORE	ACTUAL DATA
-------	-------------

	WORK SPACE	RELIABILITY	ONBOARD PWR SUPPLY	SCORE
HMMWV VARIANT 1	2 210	4	3 NO	9
HEMTT VARIANT 2	4 588 (1784)	2	4 YES	10
BRADLEY VARIANT 3	1 190+/-	1	3 NO	5
FUCHS VARIANT 4	3 236	3	4 YES	10

CUBIC FT

• S-784/G
Shelter

Figure 16 The matrix above shows that both the HEMTT and FUCHS variants earn the same raw score for the best user oriented system.

Deployability

The final criteria to discuss is the area of deployability. For this criteria there are only two sub-criteria. They are overall vehicle height and the weight of the vehicle when combat loaded. This data was readily available in a number of sources. (See Figure 17).

The Bradley has a "reducible" height as discussed in the description. (See p 43). The HEMTT and SICPs shelter combination is the tallest and the heaviest. The height could be reduced by dismounting the shelter from the cargo bed.

DEPLOYABILITY MATRIX

HIGHER IS BETTER

SCORE
ACTUAL DATA

	WEIGHT COMBAT LOADED	HEIGHT	EASE OF PREPARATION AND LOADING	SCORE
HMMWV VARIANT 1	4 10,5K	3 100 IN	4 NO PREP REQUIRED	11
HEMTT VARIANT 2	1 65,9K	1 147 IN	3 LOADED IN 2 PARTS	5 HEMMT - 62K SHELTER - 3,9K
BRADLEY VARIANT 3	2 44K	2 102 IN	2 CABLING REQ	6 REDUCED HIGHT/WGT (SEE TEXT)
FUCHS VARIANT 4	3 36,4 K	4 90.5 IN	4 NO PREP REQUIRED	11

Figure 17 Naturally the smaller and lighter vehicles would score better in the area of deployability. The FUCHS scored very well for an armored vehicle.

CHAPTER 5

RECOMMENDATION AND CONCLUSION


The compiled scores from each of the matrixes were incorporated into a final matrix to determine the best vehicle. In order to determine weighting of the criteria in the final decision matrix a survey was used as discussed in Chapter 3. The results of this survey are as depicted in figure 1.

The weighting of these criteria determine the final decision. The raw scores indicate that the best choice is the FUCHS variant as it received the highest scores in the mobility criteria and tied scores for the best in the transportability and survivability criteria.

After applying the data from the surveys (See Figure 1), the final scores place the FUCHS variant as the best choice. This is based primarily on the fact that the FUCHS scored the best in deployability and mobility which are the two most important factors according to the survey data. With the weighting factor applied, the FUCHS continues to rank the

RANK ORDER/WEIGHTING OF CRITERIA

TOTAL NUMBER POLLED • 75 TOTAL NUMBER RESPONDING • 42
TOTAL SURVEYS COMPLETE AND USABLE • 37

CRITERIA			Relative Weight
DEPLOYABILITY	37%	MOST IMPORTANT	1.0
MOBILITY	27%		.8
USER ORIENTED	27%		.6
SURVIVABILITY	37%		.4
COMPATABILITY	65%	LEAST IMPORTANT	.2

86% OF THE RESPONDENTS HAD EXPERIENCE WITH THE M677 SERIES

Figure 1 The percentages show how respondents placed each of the criteria in importance, i.e. 37% agreed deployability should be ranked as most important, 27% agreed that mobility should be second, etc. Weighting is in 1/5 increments.

best, and the margin between the FUCHS and the HMMWV was expanded (See Figure 2). Although the FUCHS scored high in other areas it's biggest problem area is the fact that it isn't currently fielded in the command and control variant in the U.S. Army.

After reviewing the data, my subjective judgement and military experience also tells me that the FUCHS is the best vehicle, for the type of mission profile that the Light

BEST VARIANT MATRIX						
HIGHER IS BETTER						
<div> <div>RAW SCORE</div> <div>SCORE WEIGHTED</div> </div>						
WEIGHT FACTOR ➤						
	SURVIVABILITY .4	USER ORIENTED .6	MOBILITY .8	COMPTABILITY/COST .2	DEPLOYABILITY 1.0	SCORE
HMMWV VARIANT 1	4 1.6	9 5.4	9 7.2	7 1.4	11 11.0	40 26.6
HEMTT VARIANT 2	4 1.6	10 6.0	9 7.2	7 1.4	5 5.0	35 21.2
BRADLEY VARIANT 3	5 2.0	5 3.0	11 8.8	4 .8	6 6.0	31 20.6
FUCHS VARIANT 4	7 2.8	10 6.0	13 10.4	5 1.0	11 11.0	46 31.2

Figure 2 Final decision matrix showing raw score totals and scores that each variant received after "weighting" each of the critieria.

Cavalry Regiment will face. It's mobility and on-board capabilites make it more suitable for the variety of conditions and terrain that the LCR may have to operate in.

The author does not agree with the outcome of the survey which weighted the selection criteria as shown in Figure 1. I believe the vehicle has to get where it is going first and then survive after it arrives. Survivability has to be the next important factor after deployability.

Conclusion

The world as we knew it for the past 40 years is changing rapidly. The Army must change just as rapidly in order to provide security for our national interests. At the same time the Army must look for ways to modernize its force while enduring a decreased operating budget.

American forces now can find themselves deployed, on very short notice, anywhere in the world. Light Cavalry as an adjunct to either a CONUS (continental United States) based contingency corps (currently XVIII Corps) or to a forward deployed corps in Europe will soon be a reality.

This study has attempted to identify a vehicle already in the Army inventory, that might be a better solution than the M577 series for a command and control vehicle for the Light Cavalry Regiment. The concept for the employment of the C2 vehicle, and what it may be required to do, varies.

Future CPs will operate dispersed in order to enhance survivability since the CP must survive first, in order to function. Today, dispersion doctrinally thought of as 3-15 kilometers in distance separating the various cells of the CP.¹ Dispersion in the future may be in hundreds of kilometers, with only the operations and current battle cell deployed forward and the plans and future battle cell

¹Contingency Force Operations, C4000-11, Section IX, Dispersed Command Posts, U.S. Army Command and General Staff College, Apr 91, p 11-I-40.

remaining at home station.

When considering the variants discussed in this study it is easy to quickly get into an "apples and oranges" discussion because some of the variants could be considered more of a fighting vehicle and as such, a good platform for the commander to use in moving around the battlefield. Other variants provide good mobility and a large work area but less protection or self defense capability. Therefore, they would be considered more of a mobile communications center rather than a fighting command and control platform for the commander to use. But, if the future holds that the mission of the LCR is to initially secure the lodgement, and next go 100-200 kilometers out and secure the expanse of area required for a corps deployment, then a communications platform is the desired characteristic rather than a "fighting/self defending" vehicle.

The FUCHS command and control vehicle meets the requirement for the future in providing the type of vehicle the U.S. Army needs. However, purchase price may be such a detractor that the FUCHS as a C2 vehicle may never become a reality in the U.S. Army.

Without a doubt, the current M577 command and control vehicle is unsatisfactory. The FUCHs best meets the requirements for a new command and control vehicle which will be able to keep pace with a fast and agile light cavalry

regiment. The FUCHs will provide the commander with a platform capable of deploying quickly and surviving on the battlefields of the future.

APPENDIX 1
SAMPLE SURVEY

Please take a few minutes to fill out this survey. The information will be used to assist in the analysis of a number of vehicle variants which are under consideration for a command and control vehicle for the proposed Light Cavalry Regiment.

As you evaluate the five categories listed below keep in mind that the purpose of this analysis is to select a vehicle which will best fill the requirements associated with rapid deployment as part of a contingency corps mission.

Have you ever served in a headquarters which was equipped with M577s Carrier, Command Post vehicle?

Yes _____ No _____

1 = Most important through 5 = least important

User Oriented ____ Survivability ____ Compatibility/cost ____

Mobility ____ Transportability ____

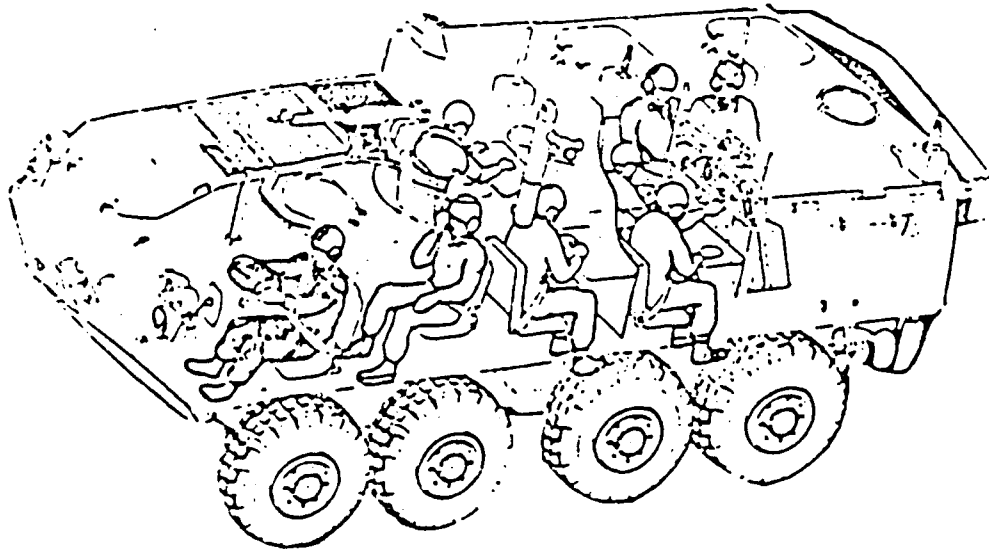
Is there another criteria not listed above in the five choices that you believe should be listed? If so please list it here.

THANKS FOR YOUR TIME AND ASSISTANCE.

APPENDIX 2

THE LAV-25

During the time that this study was produced the basic Light Cavalry Regiment (LCR) organization as discussed in Chapter 1 (Figure 3) has still not received final approval. Additional versions have been proposed to the base organization. One of the versions under consideration is based on the General Motors Corporation, LAV-25. The LAV-25 is currently in use with by the U.S. Marine Corps.



THE GENERAL MOTORS 8x8 COMMAND AND CONTROL VEHICLE

In this study, one of the limitations was that only vehicles which are currently fielded in the U.S. Army would be considered. Since the LAV-25 is already produced in a command and control variant and since the LAV-25 is currently a contender as the base vehicle for a new regimental organizational design, it is useful to briefly discuss and compare the command and control model of the LAV-25 (known as the LAV-C2) with the data presented in this study.

The FUCHS vehicle is rated best in this study and for that reason the purpose of this appendix is to compare the LAV-25 with the FUCHS and determine if it is a possible better choice for a command and control vehicle for the LCR.

Mobility

The LAV-C2 performs only slightly less than the FUCHS in the areas of range (LAV-C2, 410 miles versus the FUCHS, 497 miles). The same holds true for speed (LAV-C2, 62 mph versus FUCHS, 65 mph) and vertical height obstacle crossing capability (LAV-C2, 19.7 inches versus the FUCHS, 22 inches). Both the LAV-C2 and the FUCHS equate each other in swim capability. Both can enter the water without preparation and have almost the same maximum speed of 6.5 mph in the water.

Survivability

In the area of survivability the LAV-C2 would rate less capable than the FUCHS because it is not equipped with an NBC

over-pressure system. Currently, the LAV-C2 only has a individual crew member gas particulate system much like the Bradley or HMMWV Ambulance system. Add on armor is available for the LAV vehicle.

Compatibility

The LAV-C2 costs approximately \$650,000 (FY 92 dollars, however none are in production) which is \$250,000 less than the estimated FUCHS base cost. There are no modifications required to mount current U.S. Army command and control equipment into the vehicle.

USER ORIENTED

The work space cubic footage of the LAV-C2 is 377 cubic feet which is considerably more than the 236 cubic feet provided by the FUCHS vehicle. There is a auxiliary power supply on the vehicle.

Deployability

The LAV-C2 is taller than the FUCHS with a normal height of 110 inches however it can be loaded into the standard C-130 air transport aircraft. There is no preparation required for loading on air or sea transport. The LAV-C2 weighs in at 27,000 pounds combat loaded which is considerably less than the FUCHS' combat weight of 36,800 pounds.

Since the LAV-C2 is a close contender to the capabilities of the FUCHS vehicle the LAV-C2 should be given strong consideration as a command and control variant. If the base vehicle of the regiment is the LAV-25 vehicle, the benefits of using the same power train and base vehicle might outweigh those gained by using a totally different vehicle even if that vehicle is slightly superior in some capabilities.

BIBLIOGRAPHY

- Andriole, Stephen J. High Technology Initiatives in C3I.
Washington, D.C.: AFCEA International Press, c1986.
- Armor 2000 - Armor on the Future Battlefield. US Army Armor
Center and Fort Knox, May 91.
- Beam, Walter R. Command, Control and Communications Systems
Engineering. New York: McGraw Hill, c1989.
- Blair, Clay. Ridways Paratroopers: The American Airborne in
WWII. Garden City, New York, Dial Press, 1985.
- Cavalry Operations on the Airland Operations Battlefield.
US Army Armor Center and Fort Knox, May 90
- Chief of Staff, US Army, White Paper, 1984, Light Infantry
Divisions. Headquarters, Dept of the Army, Washington,
D.C., May 1984.
- Command and Control in North African Battles, World War II,
1941-1943. Ben-Reuven E. Army War College, Carlisle
Barracks, Pa., 19 May 89.
- Contingency Force Operations. C4000-11, Section IX, Dispersed
Command Posts, U.S. Army Command and General Staff
College, Apr 91.
- Cushman, John H. Command and Control of Theater Forces.
Cambridge, Mass: Harvard University, 1983.
- Desert Storm Archives Material
- | Partial Title | DSSSP Catalogue # |
|-------------------------------|-------------------|
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| Brigade Command and Control | DSTA44 |
| C2 | DSOP41 |
| C2 over tasked vehicle assets | DSSN13 |

Command and Control in a heavy Bde mvmt	DSTA44
Command and Control Observations	DSTA43
Interview with Col Frank Akers, G-3 XVIII	DSST12
Performance of Equipment in extreme condi	DSSN12

FM 100-5, Operations. Headquarters, Department of the Army, Washington D.C. May 1984.

FM-101-5-1, Operational Terms and Symbols. Headquarters, Department of the Army, Washington, D.C., Oct 1985.

FMC Factsheet, The XM577A3, Armored Tactical Command and Control System. FMC Corporation, Ground Systems Division, Santa Clara, California, May 1991.

Foley, Thomas C. Armor 2000 - A Balanced Force for the Army of The Future. US Army Armor Center and Fort Knox, Jul 90.

Fox, David J. The Research Process in Education. Holt, Rinehart and Winston, Inc., New York, 1976.

Goedkoop, T.R. Task Force Tactical Operations Center: An Organization for Success. U.S. Army Command and General Staff College, School of Advanced Military Studies, Monograph, Ft Leavenworth, Kansas, 27 Nov 1988.

Jane's C3I Systems. Jane's Information Group, New York, 1987.

Jane's Military Logistics. Jane's Information Group, New York, 1989.

Jane's Military Vehicles and Ground Support Equipment, 1985. Janes Publishing Inc., New York, 1985.

Jane's Armour and Artillery, 1988-89. Jane's Information Group, New York, 1988.

Johnson, Stuart E. Science of Command and Control. Washington D.C.: AFCEA International Press, c1989.

Lane, John J. Command and Control and Communications. Maxwell Airforce Base, Ala., Air University, Air War College, 1986.

Long, Dennis H. United States Army Armor Center Desert Shield/Storm Emerging Observations. Directorate of Total Armor Force Readiness, US Army Armor Center and Fort Knox, 24 July 91.

- Matthews, George F. Initial Transportability Engineering Analysis of the Nuclear-Biological-Chemical Reconnaissance System (NBCRS) FUCHS TPZ1 Version. Military Traffic Management Command, Nov 1986.
- McElwee, J.W. First Cut at Doctrine for Automation of Division Command and Control. U.S. Army Command and General Staff College, School of Advanced Military Studies, Thesis Paper, Fort Leavenworth, Kansas, 2 Dec 1985.
- Mobile Command Post Vehicles. CDOG Project Nr USACGSC 57-4, 15 July 1958. Fort Leavenworth Archives #N-18378.128B
- Northwood, Arthur. Rendezvous with Destiny- A History of the 101st Airborne Division. Greenville, Tx., 101st Airborne Division Association, 1965.
- Public Affairs Fact Sheet, Subject: Army Standards Family of Rigid Wall Tactical Shelters, S-280/G Shelter. U.S. Army Natick Research, Development and Engineering Center, Nov 91.
- Public Affairs Fact Sheet, Subject: Army Standards Family of Rigid Wall Tactical ISO Shelters. U.S. Natick Research, Development and Engineering Center, Nov 91.
- Rice, M. A. Communications and Information Systems For Battlefield Command and Control. London, Washington, Brassey's Publishing, 1989.
- Rockwell, James M. Tactical C3 for the Ground Forces. Washington, D.C.: AFCEA International Press, c1986.
- Sajo, J. R. Command Post: A Comparison of Tactical Command Post Doctrine of the U.S. And Soviet Armies. U.S. Army Command and General Staff College, Masters Thesis, Mar 1988.
- Swan, G. C. Tactical Reconnaissance fore the Heavy Brigade Commander: How Much is Not Enough. U.S. Army Command and General Staff College, School of Advanced Military Studies, Monograph, Fort Leavenworth, Kansas, 14 Dec 88.
- TM 9-2320-280-10, Change 2, Ambulance, 4-Litter, Armored M997. Oct 1987.
- Van Creveld, Martin L. Command in War. Cambridge, Massachusetts: Harvard University Press, 1985.
- Ware, H. L. Command Presence: Where Should the Operational Commander Be Located On the Modern Battlefield.

U.S. Army Command and General Staff College, Masters
Thesis, Fort Leavenworth, Kansas, 14 May 1989.

Weisband, S. P., J. M. Linville, M. J. Liebhaber, R. W.
Obermayer, and J. J. Fallesen. Computer-Mediated Group
Processes in Distributed Command and Control Systems.
Vreuls Research Corp., Thousand Oaks, Calif., Jun 1988.

Willcox, A.M. Command, Control & Communications. Oxford; New
York: Brassey's Defense Publishers, C1983.

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